THE CORNELL ENGINEER

Vol. 12, No. 4
January, 1947

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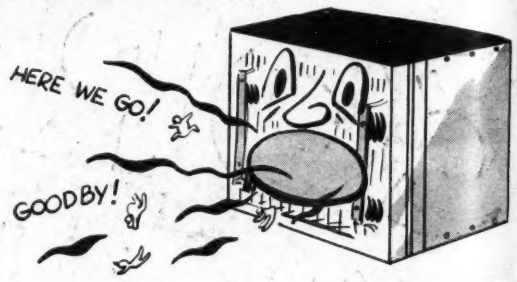
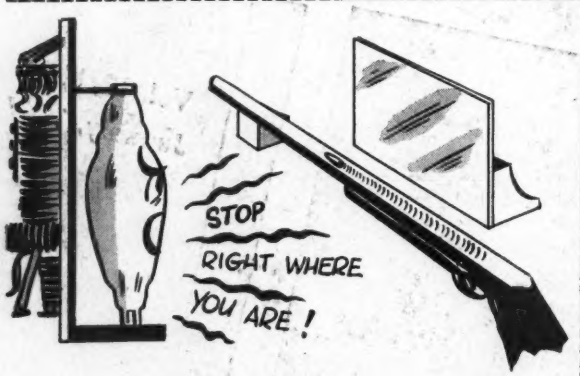
OLL[illegible]GE OF ENGINEERING • CORNELL UNIVERSITY

What's your S.Q.*?

1.—THE "RADIUM HOUND," for tracking down lost radium, is so ultra-sensitive that it can detect the presence of (a) 4 quadrillionths, (b) 25 billionths, (c) 17 thousandths of an ounce of this precious metal?



2.—THE PRECIPITRON is a device for removing 95% of all solid matter from air. It does this by —(a) capillary action, (b) electrostatic attraction, (c) osmosis?



3.—A REVOLUTIONARY X-RAY can now "freeze" the image of a bullet while traveling through a high-powered rifle. This X-ray tube takes a picture in —(a) 3/10,000th, (b) 15/100,000th, (c) 1/1,000,000th of a second?

4.—IF YOU HAD a piece of string one astronomical unit long, would it stretch —(a) 115,562 miles, (b) 92,897,416 miles, (c) one light year?

ANSWERS

1.— *(a) This electronic device . . . developed by Westinghouse scientists . . . is also useful for determining the safe therapeutic dosage of radium, radon, and X-radiation.*

2.— *(b) The Westinghouse Precipitron removes dust, pollen, smoke and other particles as small as 1/250,000th of an inch, by ionizing the particles and attracting them to electrically charged plates.*

3.— *(c) Developed by Westinghouse research engineers, this millionth-of-a-second X-ray also aids U.S. Army ballistic experts in studying the action of armor-piercing bullets penetrating steel armor plate.*

4.— *(b) This is an easy one. The picture almost gave it away; the mean distance from the earth to the sun.*

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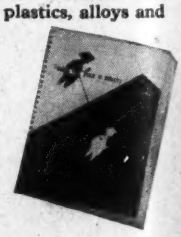

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Volume 12 Number 4

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Cover: Winter scene near the construction site of the new Administration Building on Sage Avenue.

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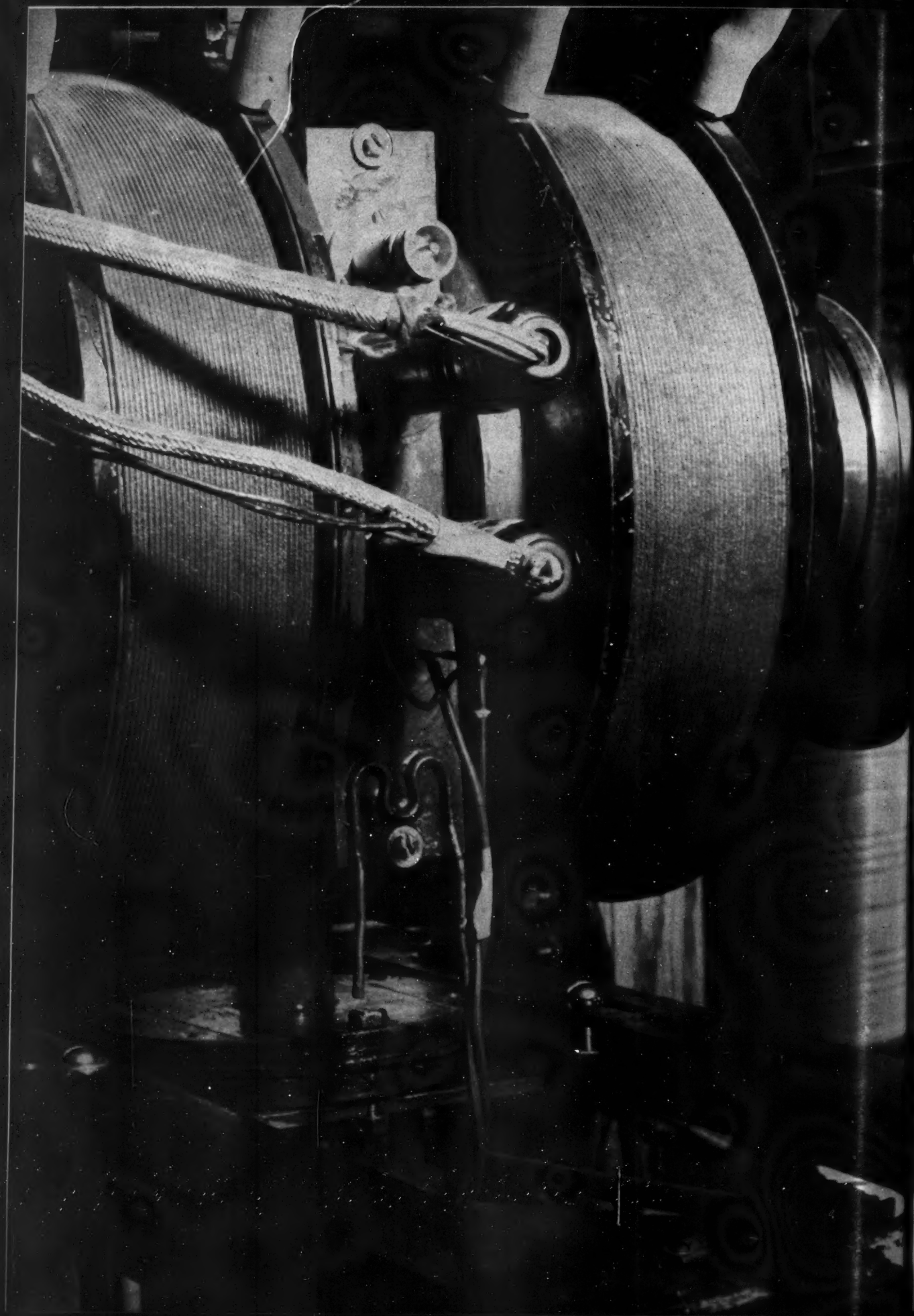


The New Department of Engineering Physics

Engineering at Cornell (19)

By LLOYD P. SMITH

Director of the Department of Engineering Physics

Cornell's establishment of the new five-year undergraduate curriculum which has been called Engineering Physics indicates the awareness of the university's administrative and technical staff of the need to provide a new type of technical education, the aim of which is to prepare men to play a more significant part in the rapidly expanding fields of scientific research and engineering development. This need arises from two main causes. One is the increasing importance, extent and growth of industrial and governmental research per se, and the other comes from the realization that a different kind of education and training is required to do industrial research in the most effective manner.

So much has been written since the war concerning the importance of research and engineering development, it seems scarcely necessary to emphasize it here. Nevertheless, a few facts concerning the growth of the nation's research effort will leave no doubt about its present importance, and may furnish clues for the future. During the past twenty-five years industrial research expanded by a factor of ten. Even before the war, before the scientists and engineers were transferred in large numbers to centers of "war research" and engineering development, there were 70,000 research workers in industrial laboratories, and expenditures for such work took place at the rate of $300,000,000 per year. With the war over, the level of expenditures is now far beyond this figure.

Industrial research organizations seem certain to grow in size and number, and in the diversity of the fields of interest. In addition, it is almost certain that government laboratories will be much larger and enormously more active in the future than in the past. Thus, all present evidence indicates that the growth of research during the past few decades will not only continue, but will be ultimately greatly accelerated. Temporarily, however, this expansion has been brought to a halt because of the lack of the necessary scientifically and technologically trained personnel. In designing the new curriculum in Engineering Physics, it was sought to provide the most effective training to meet this need.

Nature of the Training Needed

We may well ask why a different type of training is thought to be more desirable. Why not, for

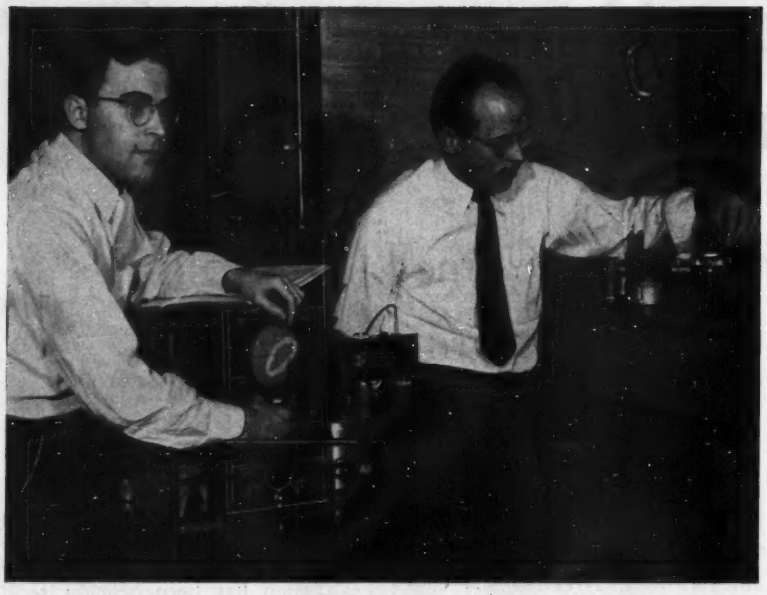
Close-up of the mass spectrometer located in Rockefeller Hall, center of Physics at Cornell. The spectrometer box is between the poles of the electromagnet. An electron beam bombards the solid sample and the resulting ions are analyzed as to their masses in the field of the electromagnet.

THE AUTHOR

Dr. Lloyd P. Smith was born in Reno, Nevada, and received his B.S. in E.E. at the University of Nevada in 1925. After a year with the General Electric Company, he came to Cornell as a Coffin Fellow in Physics and received a Ph.D. in 1930. He then went to California Institute of Technology as a National Research Fellow, and later to Europe as an International Research Fellow. He returned to Cornell in 1932 as assistant professor. Last July he became Chairman of the Physics Department.

A member of Sigma Xi, Phi Kappa Phi, American Association of Physics Teachers, and a fellow of the American Physical Society, Dr. Smith has authored and collaborated on many technical papers. He is a consultant for RCA Laboratories, and was named associate research director of the Princeton laboratories in 1945.

Dr. L. P. Smith



Equipment for the determination of elastic losses (heat built up) in plastics and elastomers under alternating tensile stress. The sample is inserted in the apparatus at upper right, and the elastic hysteresis loop is observed on the oscilloscope.

instance, leave industrial research entirely to scientists and engineers, as in the past? There are two significant reasons for believing that this is not the most advantageous thing to do. The objectives in the training of each of these groups usually are not the most advantageous thing to do. The objectives in the training of each of these groups usually are not the most advantageous for industrial research, and, as a result of their training along two quite different paths, their points of view tend to be limited and conditioned by their very different education. This last matter is by no means unimportant, because, as a result of it, the physicist and the engineer often lose their mutual respect for each other's methods of attacking problems, and the gap between their activities grows ever wider. A type of training is required which tends to bridge or close this gap.

Put extremely briefly, it may be said that the objective of the training of the professional engineer has come to be that of providing the means for him to make immediate application of well-established scientific knowledge, while the objective of the training of the scientist is to provide him with a thorough understandng of why nature behaves as it does, and the means of acquiring further scientific knowledge. An important thing to realize about modern industrial research is that the research worker is involved in technical reconnaissance in the front line region of scientific knowledge and technological experience years ahead of the "know how" and experience of production, and where well established scientific knowledge is not always available. Therefore, neither a training aimed at making immediate application of well established scientific knowledge, nor a training aimed solely at understanding and uncovering new scientific knowledge suffices. The best training should, among other things, include certain salient features of both types.

Consequently, the objective sought in the new Engineering Physics curriculum is to provide a type of training which combines the broad, basic scientific background and analytical training of the physicist, and, to a certain extent that of the applied mathematician, with the knowledge of the chemistry and properties of materials and the technological practices and methods of the engineer. It will be recognized that to achieve this objective successfully it is necessary to break down old traditional barriers that have divided the province of science and engineering into rather isolated departments of physics, mathematics, chemistry, schools of electrical, mechanical, civil engineering, etc.

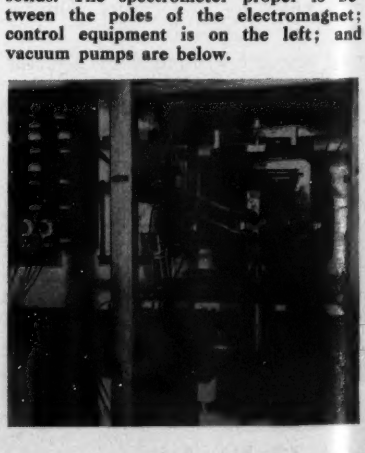
It is recognized that a rigorous educational program which successfully accomplishes the aims mentioned above must be stimulated and nourished by an active program of research. The student should have ample opportunity to rub elbows with the faculty and graduate students at work on research, since this will be the essence of his future work.

Engineering Physics

During the past summer, the Board of Trustees of Cornell University established the Department of Engineering Physics. In order to obtain the integration of pertinent subject matter, as discussed above, and assimilate the five-year course, the new department is administratively placed within the College of Engineering, but from the standpoint of instruction it has strong ties with the College of Arts and Sciences. The department will, therefore, be operated through the close cooperation of both the College of Engineering and the College of Arts and Sciences.

The Faculty of the Department is composed, in the main, of selected members from the Colleges of Arts and Sciences, and Engineering. With few exceptions, Faculty members will remain firmly attached to the departments of their professional interest. The Faculty will thus be composed of members of the Departments of Physics, Mathematics, Chemistry, and the various Schools of Engineering. A few Faculty members belong directly to the Depart-

Mass spectrometer for the analysis of solids. The spectrometer proper is between the poles of the electromagnet; control equipment is on the left; and vacuum pumps are below.



ment of Engineering Physics. A number of the present Faculty have had first-hand industrial research experience. The class and laboratory instruction take place in all of the Departments and Engineering Schools concerned. It is felt that this arrangement will lead to the greatest degree of integration of subject matter, and to a healthy cross-stimulation between basic and applied science and facilitate the exchange of new scientific knowledge and technical methods between the basic sciences and engineering.

Curriculum

The curriculum in Engineering Physics of necessity involves a five-year period of intensive study containing 180 credit hours, leading to the degree of Bachelor of Engineering Physics. To accomplish the objective stated above, the subject matter is made to cover three main categories: fundamental science. namely, mathematics, physics and chemistry; the properties and treatment of materials; and engineering practice.

For training in research, the student, in addition to various laboratory courses, terminates the course by carrying out a semi-research project in a special field of his own choice, under the direction of a faculty member who is an authority in the selected field. There are a great variety of these special fields available in physics and engineering. These fields include topics in electron physics, atomic physics, optics, x-rays and crystal structure, spectroscopy, nuclear physics, engineering electronics, communications, electrical machinery, ultra high frequency generation and propagation, circuit analysis, elasticity and stress analysis, properties of materials, mass spectroscopy, engineering mechanics, aerodynamics, etc.

Considerable flexibility in the technical courses is provided in the last few terms of the curriculum to allow the student to follow some technical fields somewhat more intensively as his interest in certain fields develops. To permit this, 17 hours of technical electives are provided which may be selected, with the permission of the student's adviser, from the following subjects:

Physics
Mathematics
Chemistry
Physical Metallurgy
Advanced Mechanics and Elasticity
Fluid Mechanics
Aerodynamics
Ultra High Frequency

In addition to this, there are alternatives in mathematics, physics, and engineering provided in the course schedule. The choice in these alternatives will depend largely on the student's particular ability or interest.

The curriculum provides for approximately 30 hours of liberal courses. Of these, there are 15 hours required and 15 hours to be elected. These electives must be chosen from the following subjects:

History of Science
American History
Psychology
Economics
Public Speaking
Business Law
Corporate and Industrial Organization
Industrial and Labor Relations

Cornell provides a new type of technical education to train men for the rapidly expanding fields of scientific research and engineering development.

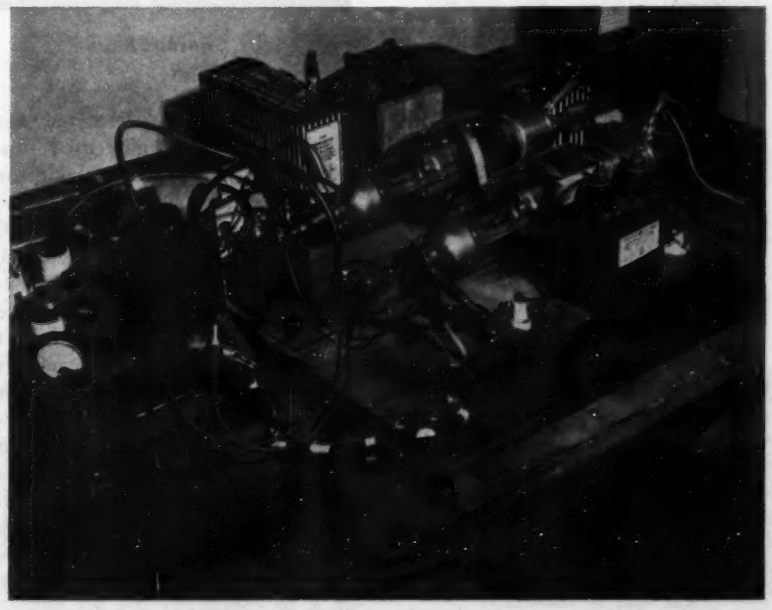
Electives in other subjects may be taken in special instances, with the permission of the Engineering Physics Faculty.

Opportunities

It is doubtless obvious that to complete successfully the rigorous training program outlined above, a student must have outstanding technical ability, and be willing to devote a great deal of his time to study. There is considerable evidence that fine opportunities lie ahead for those who complete the course. Aside from the great shortage of such technically trained men, many large industrial laboratories who received announcements of this course of study have been greatly interested, and have expressed the feeling that such a course will fill a great need. The program of study has attracted the attention of Laboratories abroad, as evidenced by letters of interest and inquiry from England and The Netherlands. Requests have already been received from research laboratories to be put in touch with members of the first class to graduate in Engineering Physics. However, there are none more interested in the progress and success of the members of the initial class who entered the Engineering Physics course this Fall than the members of the Faculty of the Engineering Physics Department. We

(*Continued on page* 34)

Laboratory set-up for the production of supersonic waves. The magnet or friction sound generator is at the left.

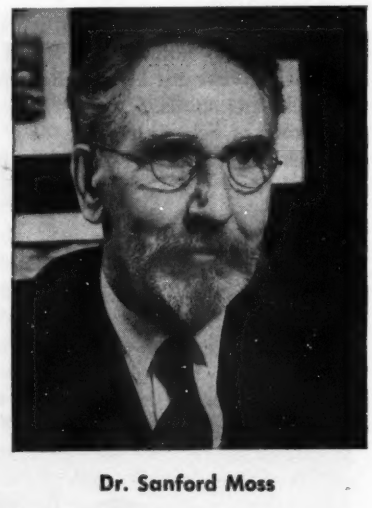


Sanford Alexander Moss

Famed supercharger developer, Dr. Sanford Moss, Cornell '03, dies at 74.

Last Nov. 19, Dr. Sanford Alexander Moss (Ph.D. Cornell 1903), inventor of the turbo-supercharger, died. Dr. Moss devoted a lifetime towards fulfilling an idea that he had when he was seventeen, that if air could be compressed, fuel could be burned in it at a great increase in energy. The idea was not thought much of at the time, for the cost of compressing the air would probably overcome the money saved in the added energy, but Moss did not let his theory drop as he attended the University of California, where he obtained his Bachelor of Science in 1896, and his Masters in 1900. He then came to Cornell, attending here as a graduate student and instructor. In 1903 he earned his doctor of philosophy degree with a thesis on the Gas Turbine, which was recognized by the General Electric Company as an idea with a definite future. He was immediately hired by GE to work in the West Lynn plant, at Lynn, Massachusetts, as a researcher on his idea of combining a compressor and a gas turbine to produce a turbo-supercharger. His research work was satisfactory and when World War I came around, he was called upon by the National Advisory Committee for Aeronautics for help in finding ways of giving military planes greater power.

Dr. Moss had a very clear idea of what his supercharger would do under almost all conditions conceivable, but the Air Corps engineers wanted to spend their time and limited funds on ways about which they were certain. However, he was given an audience in 1918 at McCook Field, Ohio, where he set to prove his "contraption" to those who could use it. By using the exhaust from a Liberty engine he forced air into the engine's carburetor at a greater pressure than would normally occur without the compressing equipment. Then sheltered behind a barricade, he opened up the throttle and the engine reacted violently. Enough of those present were satisfied that the turbo-supercharger did have an effect upon the engine operation that the Air Corps sponsored an official test at the top of Pike's Peak, where the air was considered very rarefied for aircraft in those days.



Dr. Sanford Moss

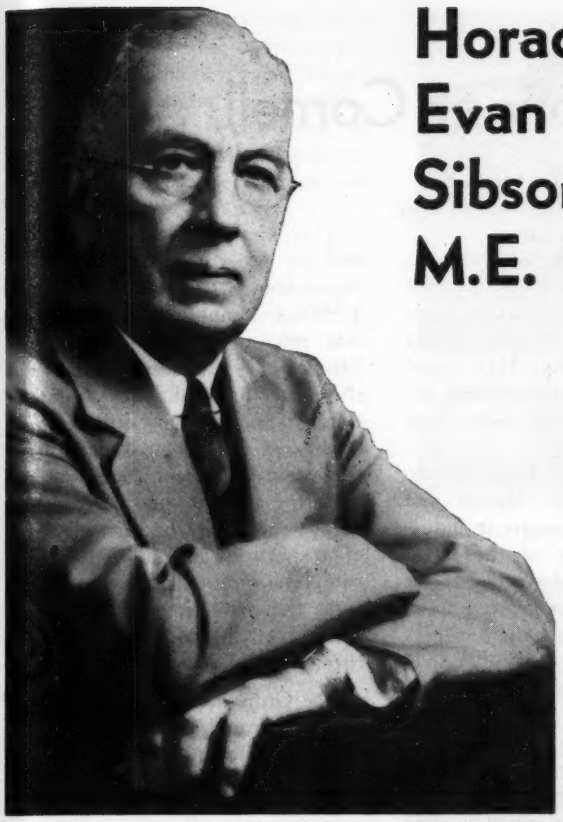
Before the party started for Pike's Peak, the engine used produced 350 horsepower without the use of the supercharger. After the climb the engine produced only 230 horsepower under those conditions, but came across with 356 horsepower with the supercharger. The Air Corps engineers still weren't fully convinced, and the aircraft makers were just willing to admit that the new invention was a worthy one, but the war ended and in 1918, only military planes wanted to go as high as Pike's Peak. Dr. Moss had achieved technically what he had set out to do, but the turbo-supercharger remained only as an experimental "gadget" for a long time.

During the '20's and early '30's, Dr. Moss applied many variations of his original instrument to aircraft, and nearly all the results were satisfactory as far as the supercharger was concerned. At 38,000 feet the supercharger functioned, but the pilot didn't, as pressurized cabins had not been built, and experiments under actual flight conditions at very high altitudes became almost an impossibility. He installed superchargers in a number of racing automobiles, but airplane manufacturers gave little interest to the uses and development. All in all he was awarded 47 patents including one for a geared supercharger driven from the crankshaft. Dr. Moss's work on centrifugal pumps and specialization in designs related to the main work has been used many times by GE in many different products. He retired from GE at sixty-five, on Jan. 1, 1938, apparently with his invention a technical success, but without the recognition of a large production.

After the Munich pact was signed, Dr. Moss voluntarily returned to GE and again worked on ways to improve his basic invention for military craft. It became apparent that war was inevitable, and the aircraft flying farther, faster, and higher would be a major factor in deciding the outcome of the war. Shortly after Pearl Harbor he again became a consultant to the Army Air Forces, but this time his case was proven to the military and production bosses, and soon Liberators and Thunderbolts and later Super-Forts were flying in a class completely outdoing all previous planes including those of our enemies. Millions and millions of dollars were spent by the government on his works during the war.

Last year Dr. Moss again went into retirement, only this time his life's work was a complete success. Technically he has given man a great invention, and he lived to see his invention help win man's greatest war. He also lived to see his invention aid peace time humanity, by transporting planes flying faster and better than ever before. We are proud to claim Dr. Moss as a Cornellian.

Horace Evan Sibson M.E. '03



—Picture courtesy The Delta Magazine

When Horace Evan Sibson, M.E. '03, passed away this Fall, the University was informed that it had been willed the bulk and residuary part of his estate, a share valued at more than eighty thousand dollars. Sibson asked that his bequest be used for the College of Engineering to help construct and equip the new Materials and Metallurgy Laboratory, or in any other manner which the Trustees consider desirable. This was his final gesture of appreciation and esteem for the school where he launched a successful and colorful career almost half a century ago.

From his early life, Horace E. Sibson showed his interest in engineering and allied subjects. He matriculated at Sibley College from the North East Manual Training School of Philadelphia, Pennsylvania in the Fall of 1899, a typical eighteen year old freshman. From then on, however, he was distinguished from the ordinary college man. Prominence came, when as a junior, he was elected Business Manager of the *Sibley Journal of Engineering*, forerunner of the CORNELL ENGINEER. At that time, too, Sibson became the active leader of the group that founded the Gamma Theta Chapter of the Sigma Nu fraternity at Cornell. Because of these activities and his general energetic and aggressive character the *Cornellian* in 1903 summed up his college days with the affix "hustler." In a word it described his undergraduate days at Cornell and was the key to his career that lay ahead.

After graduation, Sibson returned to his native Philadelphia and entered the employ of the Harrison Safety Boiler Works as a sales engineer. Cornell was not forgotten though. His sales territory included New York State so frequent visits were in order. Three years following graduation in 1906, the fledgling engineer induced the Harrison Safety Boiler Works to present a 300-horsepower Cochrane Heater to Sibley College. It was through his leadership and efforts, shortly after graduation, that land was acquired and the present Sigma Nu fraternity house, worth some $65,000, was planned, financed, and built. Another outstanding contribution to his fraternity was the development by Sibson and the adoption by the Fraternity of a national uniform accounting system, whereby individual fraternity chapter accounts were placed on a more practical and businesslike basis.

In 1909, Mr. Sibson ventured across the Atlantic Ocean and spent two months in Italy, France, and England. He enjoyed traveling and it became a hobby. The year 1911 found him again in England, in London, with the Underfeed Stoker Company. His activities still had among them thoughts of Cornell. Long a member of the Cornell Club of Philadelphia, he served as Chairman in 1915. The initiative and organizing ability in Horace E. Sibson showed up again when, in 1921, he helped incorporate the Cochrane Engineering Company of Chicago, and about that time, too, became president of the Cochrane Steam Specialty Company of Boston. The Harrison Safety Boiler Works in 1924 became the Cochrane Corporation with Mr. Sibson vice president and general sales manager. He held that position until he retired, shortly before his death. His career was a steady climb from sales engineer, to sales manager, to general manager, and to the presidency and vice-presidency of the companies for which he worked. It was said of Horace Sibson, "Bare facts do not in any way do justice to the service he has rendered our company here, nor do they express our great personal regard and respect for Sib."

As was most certainly expected, Sib followed his hobby of traveling to a great extent in the United States, and in neighboring Mexico and Canada. To keep his travels alive with him, Mr. Sibson recorded events with still and motion pictures and was constantly on the alert for new developments in that field so that he might perfect his photography. The photography supplemented his travels as an avocation. The extensive and expensive photographic equipment which had accumulated, he left to a close friend. The travels were not smooth all the time and Sib found great pleasure in exploring out-of-the-way and unfrequented places.

One trip in 1929 took Sib through the Canadian Rockies and the Columbian Ice Fields. The party was

(*Continued on page* 32)

New Gage Laboratory Established

Gage Laboratory at Cornell

By ROGER L. GEER
Assistant Professor of Materials Processing

Preceding issues of the Cornell Engineer have presented descriptions of recent additions to the College of Engineering. Now we can relate the incidents that lead to the establishment of a Gage Laboratory at Cornell, and explain the functions of such a facility to the University and also the community.

Analysis of the Mechanical Engineering curriculum at Cornell in 1939 revealed deficiencies in the courses on Industrial Processing. One of the omissions was instruction in the field of Measuring Instruments. It seemed proper then, to insert a course to study the standard tools and practices of shop measurement. Time would not permit a detailed treatment, nor was this intended, since the objective was not the training of skilled inspectors. The course served to complete the "processing" picture, and provide the student with comprehensive and integrated knowledge about the production of commercial goods.

The name, Measuring Instruments, is somewhat misleading since it implies a broad coverage—which is not the case. Measurements of time, temperature, speed, pressure, fluid flow, and hardness are not included in the course outline since they are adequately treated in other laboratory instruction. This course was restricted to dimensional inspection of commercial goods and gauges.

The importance of inspection to engineers is stressed. Design and development departments in industry must be aware of the latest shop techniques and standards for finishing parts; management must appreciate the functions of inspection as related to quality control and plant layout; research must be hunting for improved processes and new goods, often requiring creation of new inspection tools since existing types are inadequate; and sales must have an understanding of quality in order to sincerely market their merchandise.

Late in 1941, the Cornell Curriculum Laboratory participated in the organization of a series of related courses into a curriculum to accelerate the development of Junior Inspectors for Ordnance Materiel. This training program was taught at Cornell and other schools, and in other Ordnance Districts throughout the United States under ESMWT sponsorship. While this was not a program suitable for Mechanical Engineering students, the inspection and gage laboratory elements of the curriculum could readily be adapted to the needs of the engineers. Meanwhile, the engineering students had been receiving instruction in the basic elements of inspection and also the more complete picture of what constitutes the manufacturing of a completed article from raw material through final inspection.

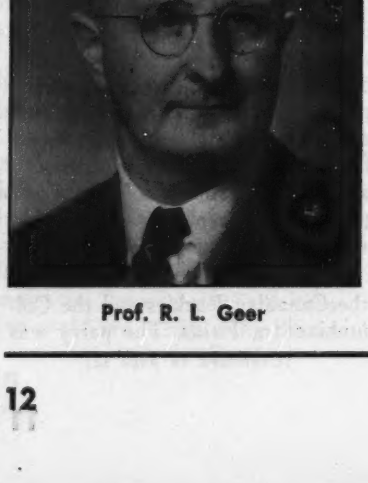
The Ordnance Training Program ended February 1943, after training over 300 men and women. Since the war, we have contracted with the Rochester Ordnance District to maintain, in operating condition, a gage laboratory. Equipment left from the training program plus additions from plant excesses have provided us with a fairly complete laboratory.

This equipment, valued at about $50,000 is now housed in temporary quarters on the top floor of Rand Hall. Furniture for a class of 18 students is available, and teaching aids such as wall charts, films, and mock-ups are on hand to facilitate instruction when the actual piece of equipment is not available.

The course includes 15 laboratory periods of 2½ hours duration. Demonstrations and discussions require about one hour of each period, the remainder being devoted to use of the equipment at the various inspection stations. Each student fills out an inspection report for the work he does. Some of the tasks, such as Surface Plate set-ups, are worked out on a team basis. Care has been exercised in the program of lesson topics, so that a logical and integrated sequence results.

The first four weeks are spent in studying measuring tools most

THE AUTHOR



Prof. R. L. Geer

Roger L. Geer, Assistant Professor of Materials Processing in the School of Mechanical Engineering, was born in Marathon, N. Y. He received his degree in Mechanical Engineering at Cornell in June, 1930. Until 1934, he held the position of industrial engineer for the Perfection Stove Company in Cleveland, Ohio, and from 1934-1939 was associated with the Smith-Corona Typewriter Company in Groton, N. Y. In 1939 he joined the faculty at Cornell. He is a member of the ASM, SPEE, and AFA. Prof. Geer is Acting Director of Materials Processing in Rand Hall.

common to the machine shop. These include scales, calipers, micrometers, verniers, gage blocks, surface plates and their accessories. The origin and development to their present form, as well as proper usage of each tool is demonstrated and practiced.

The laboratory contains a good variety of rules from 1″ to 36″ and steel tapes to 50 feet in length. Calipers and dividers from 3″ to 24″, straight edges up to 72″, surface plates from 15″ x 15″ to 24″ x 36″, parallels up to 1½″ x 3″ x 12″, and angle irons and squares up to 12″ blades are available in quantity so that multiple stations are possible.

A generous supply of micrometers from 1″ to 12″, both outside and inside, as well as depth micrometers to 3″ capacity, are on hand. These are in almost constant use.

Vernier calipers to 48″ capacity and height gages to 18″ are kept in plush-lined cases when not in use—which is seldom.

The continuous use of gage blocks as size reference standards requires several sets to provide adequate student participation. At present we have two sets of the Hoke design and three sets of Johannson style —one of the latter is accurate to 4 millionths and is used as a master for checking the other sets.

It becomes readily appreciated that measurement to a precision of tenths of thousandths cannot be accomplished consistently unless some device is available to provide constant pressure on the measuring contacts.

Such a feature is built into the tailstock of the Supermicrometer, see Fig. 1. The knurled knob at the left adjusts the tailstock pressure to either 1 or 2½ lbs. The white window on top covers a pointer that moves to an engraved line when the pre-set pressure has been reached. The knurled micrometer screw at the headstock can be rotated through a range of one inch, and readings can be made to .0001 inch.

This instrument has a capacity from 0-9 inches, by using the eight one-inch rings (accurate to 10 millionths of an inch) for setting the tailstock. We are very fortunate in having more than one of these in our laboratory.

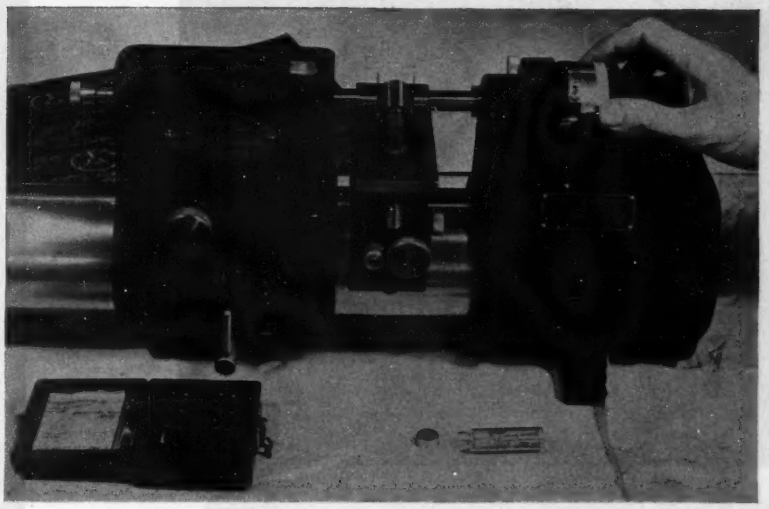


Figure 1.—The Supermicrometer, capacity 0-9 inches, shown measuring pitch diameter of a thread plug gage.

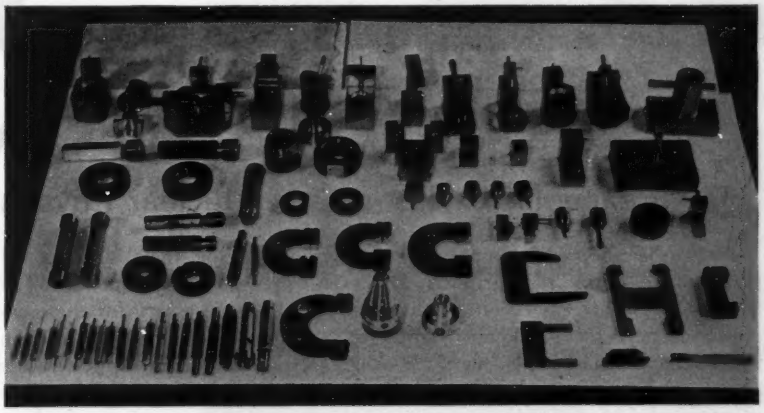


Figure 2.—Fixed gages, varying in cost from $6.00 to over $600 each, for inspecting the body of M77 fuses. This group is valued at $5200.

In order to assure consistent measuring pressure on Surface Plate inspections using Gage blocks, Height Gages are generally fitted with a small dial gage or test indicator. These are mechanical magnifiers (gear trains) calibrated to read in either thousandths or ten thousandths of an inch. They permit reading of slight differences in measurement—or may be used as a contactor with tools to indicate that readings are taken under same pressure conditions.

The array of test indicators and dial gages is quite complete both in quantity and variety.

Pressure schemes are incorporated in many other devices so that standardization of measurement is understood throughout the country. Thus we can effect sub-contracting of parts and yet achieve precision and interchangeability since everyone does measuring under specified conditions.

Angle measurements as well as thread and gear inspection require some specialized equipment, and the laboratory is in need of such devices as a Universal dividing head, Vinco Master indexing head, and angle gage blocks. These are demonstrated by slides and charts. Gear inspection equipment—a highly specialized group of apparatus—is also lacking. These techniques are covered by use of films and film strips.

Thread inspection is covered by use of fixed gages (both ring, snap, and plug) and also use of projection comparators. Fixed gages of simple forms are generously supplied, especially in such demonstrations as Fig. 2. These gages are re-

(*Continued on page 26*)

Above: The huge Van de Graaf generator at the Westinghouse Research Laboratory supplies energy for atom-smashing.

Right: This 40-foot vacuum tube, one of the largest in the world, is an integral part of the atom-smasher.

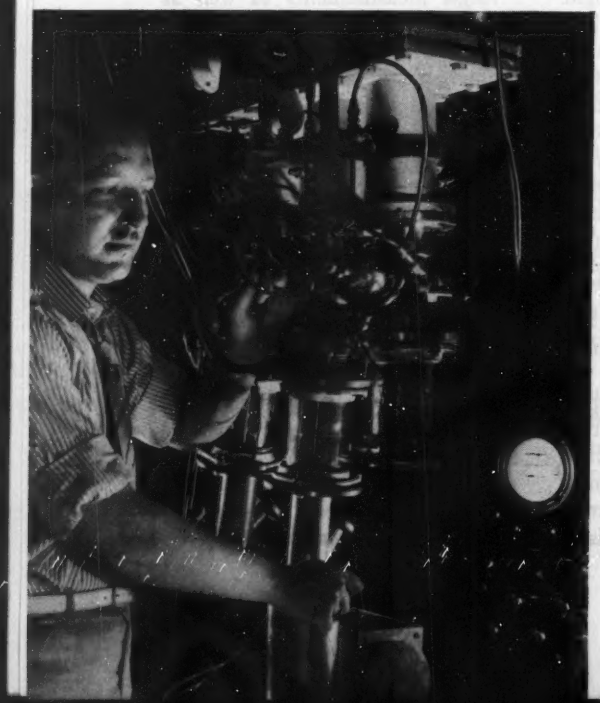
THE ATOM

Peace Time Research in Nuclear Physics Gains Momentum

After the spectacularly impressive atomic bomb test at Bikini, nuclear physicists are turning their efforts to peaceful developments of this source of energy. To them, the six atomic explosions and development of the atom bomb are only "whistle stops" along the road to a better civilization.

Universities and industrial concerns have embarked on a program expanding their facilities for atom-smashing experiments. The high voltage necessary for these experiments is usually produced in gigantic Van de Graaf generators such as the one pictured here. Tremendous voltages are required to accelerate the tiny, invisible ions toward their target of fissionable material. One of the recent advances in the study of atomic structure is photo-fission, the splitting of uranium atoms high-energy gamma rays.

Real possibilities for utilization of this tremendous source of energy lies in the fields of medicine and biology, in improving transportation and industry, and in the economical generation of electric power.



Right: From a tube secured in this casing, ionized particles are hurled at samples of material at the bottom of the vacuum tube.

Left: The target is at the base of the tube. With this apparatus, scientists discovered photo-fission. Dr. W. E. Shoupp, one of the directors of atomic research at Westinghouse, adjusts the apparatus.

—All cuts courtesy Westinghouse

ELECTROPULT LAUNCHES JET PLANES

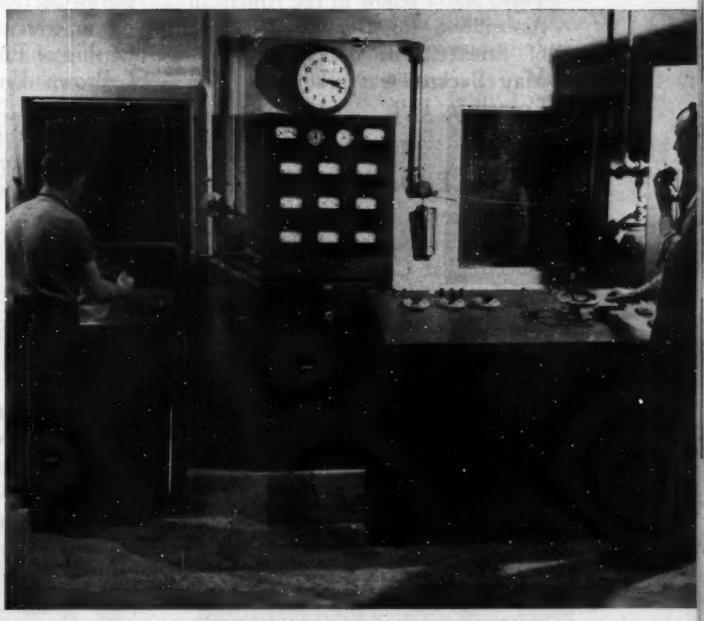
Unique Device Facilitates Split-second Take-offs

A linear electric motor more than a quarter of a mile long is the latest answer to the problem of launching jet-propelled planes from small landing fields—or even from shipboard—without the initial impact of conventional catapults.

The new device, called the Electropult, is essentially a huge electric motor laid out flat. The 1382-foot track corresponds to the rotor of a conventional machine and a small shuttle car which runs along it acts as the stator. The plane, attached to the car by a steel cable, is towed down the track until it has attained flying speed. The car is stopped, the cable drops off, and the plane takes to the air.

In recent tests at Patuxent River, Maryland, the loaded electropult developed a speed of 116 miles an hour in four and one-tenth seconds. Designs have already been completed by Westinghouse engineers for an Electropult capable of launching the largest existing airliners at 120 miles an hour in a run of 500 feet. Other possibilities for Electropults are aircraft carriers, mid-city airports, and ocean-going airdromes.

***Right*: The plane can be launched at 116 miles per hour in a few seconds.**



***Right*: Control room for the Electropult.**

***Below left*: Linear motor track of the Electropult. The central portion of the track is the core of a 1382-foot long linear induction motor.**

***Below right*: This jet-propelled plane has just taken to the air after being towed only 340 feet.**

News of the College

Gift Received

A gift of $1,000 has been received from Cyrus D. Backus of Silver Spring, Md. by Cornell University. The use of this fund, the Cyrus D. Backus Fund, will be determined by a further conference with the donor. A Cornell graduate in 1896, Backus is a patent attorney with International Telephone and Telegraph Corp. For many years he was on the examining corps of the U. S. Patent Office in Washington, D. C. He is a member of the American Institute of Electrical Engineers, Institute of Radio Engineers, Cosmos Club of Washington, Cornell Clubs of Washington and New York, and a fellow in the American Association for the Advancement of Science. His daughter, Lucile May Backus, was graduated from Cornell in 1936.

New C.E. Design Booklet

After seven years of research by the staff in the School of Civil Engineering at Cornell on a program sponsored by the American Iron and Steel Institute, a booklet was recently published by the Institute entitled, "Specification for the Design of Light Gage Steel Structural Members." The research program and the published information were undertaken in response to requests from building officials, engineers, architects and builders for design standards to govern the use of light gage steel members for structural purposes in buildings and similar structures. The program has been under the direction of Dean S. C. Hollister and Professor W. L. Malcolm, director of the School of Civil Engineering, with Dr. George Winter, associate professor of civil engineering, in immediate charge. The research group made a study of the available engineering literature on the subject, and conducted tests on beams, studs or light columns, and deck constructions involving nearly 700 structural specimens. In presenting the design specifications, the Committee on Building Codes of the Institute issued a statement to the effect that while the specifications did not pretend to provide final and conclusive answers to all design problems, they would "afford sufficient data for a sound and rational basis upon which to design structures formed of sheet and strip steel."

American Chemical Society

Dr. J. G. Kirkwood, professor of physical chemistry, gave a paper entitled, "The Theory of Optical Rotary Power," at a convention of the Division of Physics and Chemistry of the American Chemical Society, which was held Monday and Tuesday, December 30 and 31 at Northwestern University. The symposium, which was under the chairmanship of Professor Paul C. Cross of Brown University, had as its main subject, "The Color and Electronic Structure of Complex Molecules." Subtopics included in the symposium were: "Experimental Methods and Results on Unsaturated Hydrocarbon Derivatives;" "Optical Rotation and Fluorescence," and "Results on Dyes, Large Molecules, and on the Vacuum Ultraviolet."

Appointments

C.E. Appointments

David E. Donley, formerly chief of the hydrology unit, U. S. Engineer Department, has been appointed associate professor of civil engineering. Professor Donley was graduated in 1926 with the degree of Bachelor of Science in chemical engineering at the University of West Virginia and in 1932 received the C.E. there. He worked as associate hydraulic engineer with the Tennessee Valley Authority from 1934 to 1940. In March, 1940 he joined the War Department in Washington until January, 1941, when he began active army service with the Engineer Reserve. He was retired from the army as Lieutenant Colonel, Ordnance Reserve on January 16, 1946.

Taylor D. Lewis has been appointed to the rank of assistant professor in civil engineering. Professor Lewis received a B.S. in chemical engineering in 1934 at the University of Michigan. He has been employed successively in the Connecticut State Highway Department, as traffic manager for the Globe Indemnity Company, and as traffic engineer in Kansas. From 1940 until his discharge with rank of Lieutenant Colonel in 1946, Lewis served in the United States Army. From then to date he has been with the Yale Bureau of Highway Traffic.

Chem. E. Appointments

Dr. Robert L. Von Berg was appointed Assistant Professor in Chemical Engineering at the beginning of the fall term. Dr. Von Berg holds the degree of B. Chem. Eng. and M. Sc. in Chemical Engineering from West Virginia University. In 1944, he was awarded the degree of Doctor of Science from M.I.T. From February 1944, until February, 1946, he was employed in the Industrial Engineering of the du-Pont Company.

Dr. Herbert F. Weigandt has been appointed to the rank of Assistant Professor in Chemical Engineering. Professor Wiegandt was graduated from Purdue with a B.S. in 1938 and from there received a M.S. in 1939, a Ph.D. in 1941. As chemical engineer he worked for the Standard Oil Company of Indiana from June 1941 to February 1944. From then to date he has been working on various research projects for the Armour Research Foundation in Chicago.

Mr. Malcolm S. Burton was appointed Assistant Professor in Metallurgy in Chemical Engineering at the beginning of the fall term. Mr. Burton is a graduate of Worcester Polytechnic Institute with the degree of Bachelor of Science of Mechanical Engineering. He also holds the degree of Master of Science in Chemical Engineering from M.I.T., where he has been a member of the staff.

Professor Peter E. Kyle has been appointed as Professor of Applied Metallurgy in the School of Chemi-

(*Continued on page* 32)

Robert Fox Bacher

We all know that in a sense the last war was a scientific and technical race with our enemies, and that the problems of co-ordination of the various individual efforts were of a magnitude never before encountered. To deal with co-ordination, the United States needed individual men who were talented in all the fields related to a specific project, and in many cases it was almost impossible to find men fitting the qualifications. In the greatest of all the war undertakings, that of the Atomic Bomb, Cornell is proud to have supplied a scientist who had the necessary knowledge and leadership to direct several fields simultaneously in divisions of that project. Doctor Robert Fox Bacher, Prof. of Physics and Director of the Laboratory of Nuclear Studies here at Cornell, possessing an ability to combine tremendous scientific knowledge with untiring efforts, superb common sense, and high administrative capacity, became a key man at the Los Alamos Laboratory Atomic Bomb Project. In 1943 he was appointed Head of the Experimental Physics Division there, at a time when most of the problems of the bomb were those of physics. In the following year he was appointed Head of the Bomb Physics Division when most of the work had been shifted to the specialized lines. At Los Alamos Prof. Bacher was responsible for from twenty to fifty top-notch professional physicists (Ph.D., Professor, etc.) and a thousand other physicists and technicians and assistants.

"Mankind's successful transition to a new age, the Atomic Age, was ushered in July 16, 1945, before the eyes of a tense group of renowned scientists . . . coolest of all was the man charged with the actual assembly of the vital core, Dr. R. F. Bacher of Cornell . . ."

—War Department Release on New Mexico Test.

Bacher received his doctor's degree from the University of Michigan in 1930, having studied particularly with Dr. Goudsmit. He has worked in a great variety of fields always being quick to recognize the growing importance of a new field.

Bacher's early work was connected with Spectroscopy, and his contributions in this field are both theoretical and experimental. In 1932 with Goudsmit, he wrote *Atomic Energy States,* which is still the standard work on that subject. He made important contributions to the theory of the spectra, particularly the effects which are left out of the usual theory, such as the interactions of the various configurations of the electronic shell. He noted that the spectra of the nucleus was similar to the spectra of the atom; his work led in the natural way to the investigation of nuclear electronic quadruple moments by means of hyperfine structure.

From 1930 to 1935, Dr. Bacher attended the California Institute of Technology, the Massachusetts Institute of Technology, and the University of Michigan on fellowships, and was an instructor at Columbia University. Most of the work done by scientists at that time was centered around the effects of the nucleus, but Bacher, upon arriving at Cornell as an instructor in 1935, increased emphasis of his experimental work on the actual occurances in the nucleus, and approached the new problems in a very direct manner, being particularly interested in neutrons. Prof. Bacher was the first to get positive evidence for the smallness of elastic scattering of fast neutrons by heavy nuclei. Shortly before the war he developed a neutron velocity selector, by making a precision instrument from a spectrometer which had previously been

(*Continued on page* 38)

PROMINENT

Andy

Laverne R. Anderson, EE

"Aw! Come on, just one more beer before you close!" Every Saturday night about one, Andy emits these famous words. The Delta Club, recognizing Andy's high qualifications for membership, initiated him in the summer of 1945. From there, he became vice president, and is now president of the club.

Laverne R. Anderson saw his first ray of electrons in June 1926, at Jamestown, New York. After a lapse of some seventeen years, Andy was graduated from Jamestown High School, ready and eager to start his college career.

That fall, he entered Syracuse University to study Chemical Engineering. At the end of his first term there, Andy joined the Navy under the V-12 program. He was then sent to Cornell to continue his education.

It was at this point that Andy saw the error of his ways, and transferred from Chemical Engineering to Electrical Engineering. In the summer of '44, Andy got the idea that he wanted to become a compet for the Editorial Board of the CORNELL ENGINEER. When Andy returned to Cornell as a civilian in the fall of '45, he soon worked his way through the organization, becoming Managing Editor, and finally Editor-in-Chief in the spring of '46.

Andy is a member of Eta Kappa Nu, and Tau Beta Pi, serving as vice president of the former during the past spring term. Also an active member of the student branch of the AIEE, he has been vice chairman of that organization.

Although he has good intentions, his study habits are rather irregular. Rooming with two other EE's in Sage, there is always someone coming into the room on the pretense of comparing work. These visits usually turn out to be the start of a jaunt to Collegetown or of a bull session.

This past summer, Andy worked in a window plant at Jamestown, making metal window frames. Working on a bonus plan was very suitable to Andy. Very often during the day Andy would stroll out behind the plant to smoke and chew the fat with the rest of the eager beavers.

This term Andy is instructing in DC machinery computations. Here he admits that he is doing as much, if not more studying, on the subject than the students taking the course.

Now in his final term at Cornell, Andy expects to receive his BS in EE degree this February. After graduation, he would like to go into research or commercial engineering, and later come back to study to study for his Masters degree.

William S. Wheeler, ME

An outstanding Cornellian in the classroom, extra-curricular activities, and on the Schoellkopf gridiron is Bill Wheeler, ME '47. Many of you are already familiar with Bill's outstanding work as halfback on the Big Red teams of '41, '42, and '46.

William S. Wheeler was born in Evanston, Illinois twenty-four years ago, and has made his home there ever since. After leaving Evanston High School, Bill entered Cornell in September 1940, holder of a McMullen Regional Scholarship and the Cornell Club of Chicago Scholarship. During his first year here, Bill played freshman football and joined Psi Upsilon fraternity.

In 1941, Bill moved up to the varsity football squad and continued his play in 1942. After the Penn game of the latter season, Bill Wheeler was elected co-captain of the football team for the following season. But the man with the whiskers had other plans and he left Cornell with the Ordnance ROTC unit in May of 1943.

Bill transferred to the Air Corps and became a navigator and radar operator on a B-24. After a tour of duty as radar instructor at Victorville, California, he was assigned to the First Photo Reconnaissance Squadron which was assigned the mission of "pin-pointing" and mapping the location of enemy radar stations in Japan, in preparation for the then-impending invasion of the home islands. Other factors, however, brought the Pacific war to a sudden end and Bill was transferred to the 7th Geodetic Control Squadron, which had just undertaken the ambitious task of mapping the world. This job was to take ten years and Bill had little inclination to see his part of it through.

So in March 1946, Bill reentered Cornell to resume his interrupted quest of a BSME degree. Upon his return he was elected president of Sphinx Head and vice president of the Interfraternity Council. Bill is also a member of Red Key, Atmos (honorary society in mechanical engineering), and Tau Beta Pi.

Bill's principal hobby is photography and he does most of his photographic work in the Mech

(*Continued on page* 30)

Bill

ENGINEERS

Wilbur O. Gundlach, AEME

Last June the Cornell crew invaded the Far West and returned victorious in the first International Regatta ever held in this country. Number Five man in the winning shell was Will Gundlach, back at his old spot after three years in the Navy.

Wilbur O. Gundlach was born in Missouri in 1923, but has spent most of his life in Plainfield, New Jersey. After being graduated from Plainfield High School, Will entered Cornell as a McMullen scholar in the fall of 1941. During his freshman year he joined Phi Kappa Psi, earned numerals in crew, and won the Kappa Tau Chi award for having the highest average in Administrative Engineering for the year.

The following year, Will counseled at Freshman Camp and was a member of the Freshman Orientation Committee. In February, 1943, he was called to active duty as a naval air cadet. After pilot training in North Carolina, Georgia, and Oklahoma, Will won his pilot's wings as Pensacola and was commissioned. The Navy then sent him to Miami for further training as a Torpedo Bomber Pilot, and while there, Will married his high-school sweetheart, Adele deVitalis. In August 1944, he joined his ship, the escort-carrier "Sargent Bay," and flew patrol duty from her around Hawaii, Guam, the Philippines, and much ocean in between. Will later flew as landing support for the Marines all through the Okinawa and Iwo Jima campaigns. During the latter operation, he was forced down on Iwo Jima when it was half-taken. On another occasion, he was the victim of a water crack-up, out of which he was fished by a destroyer. While in rest camp on Guam, Will received word of the birth of his son, Robert Bush Gundlach, known to all as "Skipper." In July he returned to the States for a months leave with the Distinguished Flying Cross, Air Medal, Navy Unit Citation and three battle stars on his Pacific campaign

(*Continued on page* 30)

Will

George R. Ramandanes, EE

Many engineers, when asked how they got into their particular field of study, would say that they had decided many years ago what they wanted to do and had entered the appropriate school. As simple as that, for many; but George Ramandanes entered Electrical Engineering only after a long struggle.

George was born and bred in Erie, Pennsylvania, and was graduated from the Erie Academy in January 1943. During high school, model airplanes were his hobby and he captured several prizes with his gas models. This probably helped convince him that he should make airplane construction his vocation and he entered the University of Pittsburgh right after high school graduation as an aeronautical engineer. After a term of this, however, Uncle Sam tapped him and George landed in the Navy. The Navy couldn't see George as an airman so they shoved him into electricians school. After completion of this course, he was convinced that electricity was his field and he signed up for V-12. But the Navy had changed its mind again and when he arrived at Cornell in March, 1944, George found himself in the Arts school. After four terms of struggling there, the Navy again changed its mind and

George

George was again transferred—this time at his own request—to the electrical engineering school.

Now that George is back here as a civilian, he is philosophic about it all. "After all," he says, "it did relieve the grind a helluva lot." Of course the fresh view of mind may be due to the delightful summer he spent as a guest of the "52-20" Club.

George has done a little more wrestling, however, than with his problems. He wrestled for the University for a couple of seasons and owns a "C" for varsity wrestling. Always a staunch supporter of the social life, George has become one of the pillars of the Delta Club. In fact, he has been named official keeper of the "beer money" or treasury, if you will. Right now he is also sweating thru the job of secretary for the AIEE.

On one of the most important characteristics for success, the ability to mix with people, George is right out on top. The rustling of paper you hear from his room on Saturday afternoons is not a report but the necessary sound-effects accompanying any good blackjack game. The room seems to be a meeting place for EE's. Three of them live there, and most of the rest seem to be dropping in and out all the time. When one opens the door, the usual greeting is "get the heck out of her, I'm studying"—but upon closer examination one usually finds that a bull session of some sort is going on, or that one can be started at will.

Techni-Briefs

X-Rays Study Body Strain

Millionth-of-a-second X-ray pictures are now being used to study the bodily distortions a flier endures when he makes a crash landing or is catapulted out of a crippled speed plane.

In crash landings, for example, fliers undergo a shock equivalent to 10 times the shock to a motorist if he could halt his automobile in one second from an 85-mile-an-hour speed. Body harnesses have been devised to cushion such deceleration blows, but the strain on organs still poses a problem.

By simulating actual flying and crash conditions in the laboratory, X-ray studies of the body can be made while the body is subjected to strains. Sequence photographs can be arranged to show the step-by-step distortion of the organs, which are stopped dead by millionth-of-a-second exposures.

Jet age planes are cracking old speed marks so fast that the Army Air Forces this week predicted that future planes would be zooming through the air at 1,000-mile-an-hour speeds, 300 miles faster than the speed of sound. If a man tried to climb out of a supersonic plane whose engine failed, he would be cut to ribbons by the wind, so a mechanical arrangement has been devised to literally fire him out of the airplane simply by pushing a button. The high accelerations necessary to get the pilot out so he can parachute to safety give his organs a jolt 20 times as severe as the normal pull of gravity.

X-ray study in ejection seat "body bending," as well as studies of the proper amount of explosive force required to fire pilots out of the cockpit, are included in the aero laboratory investigations.

The study of bodily distortions is the most recent of a number of unusual applications in the medical, ballistic and industrial fields for the high speed X-ray unit. It was used during the war for experiments in connection with the atomic bomb as well as for studies of shells, bullets and armor plate. Peacetime possibilities include the study of swiftly-moving machine parts while they are moving.

The speedy exposures—20,000 times as fast as the normal exposure for routine medical X-rays—are accomplished because of a special electronic tube which operates under high momentary voltage. When this voltage is applied, electrons speed at approximately 100,000 miles a second in their flight from the tube filament to the anode "target" at which the electrons are aimed.

Radio Directioning and Ranging Station.

—Courtesy Westinghouse

Man-made Snow

Man-made snow, every bit as real as the "white Christmas" kind, has been produced for the first time by Vincent J. Schaefer.

Although the snow was created in a laboratory cold chamber, he believes that the technique used will work just as well out-of-doors to make actual potential snow crystallize and shed their snow when and where man wants it. In pursuit of this possibility, he plans to conduct experiments from an airplane in natural clouds during the next few months.

According to Schaefer, natural clouds from which snow is formed consist of "supercooled" water droplets. Water in this condition is not frozen, even though it is far below the freezing temperature. This phenomenon, the reason for which remains a mystery, is the chief cause of icing on airplanes, he said.

In a laboratory cold chamber similar to a home freezing unit, Schaefer first artifically produces a "supercooled" cloud by dropping temperature to about minus five degrees Fahrenheit and then introducing moist air from his breath. The moist air condenses into a fog of "supercooled" droplets.

Then, to provide nuclei upon which snow crystals can be built, he seeds the cloud by passing through the chamber a tiny pellet of dry-ice, which is solid carbon dioxide at a temperature of minus 70 degrees Fahrenheit. This seeding also can be accomplished by the alternative method of passing through the chamber a small metal rod, cooled below minus 31 degrees Fahrenheit.

"The seeding results in the formation of submicroscopic ice particles in the air close to the surface of the cold object, whether it be dry-ice or metal rod," he explained. "The mechanism of formation is not fully understood, but an almost infinite number of these ice germs form in this manner."

Once started freezing, the crystals begin growing at the expense of the water particles, and within a few seconds the fog vanishes. In its place appears a cloud of tiny snowflakes, glinting in a special light beam set up in the cold chamber for better visibility.

According to Schaeffer, the snowflakes produced are about 1,000 times larger than the original ice crystal seeds, but yet are about 1/50th the size of an average natural flake. Thus, to study them, it is necessary to use a plastic replica method he developed just prior to the war.

The tiny flakes are permitted to fall on a thin film of rapidly-evaporating plastic solution. Each flake becomes encased in a plastic shell, through which water evaporates, leaving an exact reproduction of the flake in the form of a cast.

Examined in this form under a microscope, the flakes prove themselves to be geunine snow crystals, similar to the "diamond dust" that falls on cold mornings in the mountains.

Cornell Society of Engineers

107 EAST 48TH STREET 1946-1947 NEW YORK 17, N. Y.

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"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Message

I am getting tired of the picture that has been in the upper right-hand corner of this page in the last few issues, so this time you see Mr. Paul O. Reyneau, the Society's efficient secretary and treasurer.

The officers and committee chairmen know how much the success of the Society depends upon his conscientious work, but we want the membership as a whole to know and appreciate Paul Reyneau. For the past eight years he has furnished the continuity which carries the Society smoothly over from one year to the next while new officers and committee chairmen are getting the run of things. If we didn't have his quiet push at just the right moment I am sure the Society wouldn't be as healthy as it is.

I suppose it was Paul's boyhood abroad in Spain, France and England, and a wide background, which enables him to handle the many situations which arise within the Society. After leaving Cornell in 1913 as one of the charter members of Telluride and one of the four who opened the original House, he spent time with the Detroit Edison Company, Philadelphia Electric Company and American Gas Company. He then spent some years with the Western Electric Company before joining Cornell Placement at the Cornell Club in 1934. In 1943 he became manager of the New York City office of the Cornell University Placement Service.

This important work naturally keeps Paul Reyneau very busy, and, since your Society has always supported the work of the Placement Bureau, a bit about its past and present may interest you.

A resolution presented by our past president George N. Brown at a Cornell Alumni Association convention a few years ago resulted in the formation of a Committee on Alumni Placement. Paul Reyneau now runs the New York office of the University's Placement Bureau. The headquarters are naturally in Ithaca, where the work is directed by John L. Munschauer. Through these years a splendid technique of taking care of alumni needs has thus been evolved.

All who register are given careful assistance, by interview or mail, in the proper presentation of the record of their background and experience. A pamphlet containing suggestions is furnished them. This results not only in helping the employer select prospects for interview, but also helps the applicant in presenting his qualifications orally when he is being interviewed.

Up to the present time over 3000 alumni have filed records in the New York office. The Placement Bureau uses this material to publish and distribute to over 1200 companies brief experience resumes of those who have registered.

Cornell's Placement Bureau ranks high among similar collegiate bureaus in the New York district. Finding jobs for Cornellians is just part of what Paul Reyneau tries to do. It is fitting a man to the job and the trust that employers have in his judgment that is his forte. These are the many contacts and experiences which make Paul such a valuable officer for the Cornell Society of Engineers.

Robert B. Lea

Alumni News

C. Scott DeGoyler, C.E. '10, holds the position of Supervisor of the Town of Castile, New York. While studying at Cornell, Mr. DeGoyler was on the Varsity Track Team, and the Varsity Cross Country Team. In 1908, he won his "C" for his activities with the Track Team.

Max Grossman, C.E. '12, has been appointed a member of the New Jersey Water Policy and Supply Council by Governor Edge. The Council is charged with great responsibility in maintaining and improving the fine water supply systems of the State of New Jersey. Mr. Grossman is also the Engineer and Assistant Superintendent of the Water Department of Atlantic City, New Jersey.

Harland B. Cushman, M.E. '16, has taken a position with the Seabrook Farms, of Seabrook, New Jersey, as Assistant Plant Manager of the Quick Freezing Food Plant. Mr. Cushman was a member of Alpha Chi Rho, while at Cornell.

Robert W. Graham, M.E. '16, is District Chairman of the Buffalo District Section of the Association of Iron and Steel Engineers. Mr. Graham has been active in the steel industry since 1916, except for a year and a half of naval service in the first World War. He started with the Lackawanna Steel Company as assistant, electrical engineer and remained in that capacity until the Lackawanna plant was taken over by the Bethlehem Steel Company in 1923. He was then appointed assistant superintendent of the electrical department until 1943, when he became electrical superintendent. Mr. Graham also taught in the School of Engineering for three years.

James Aylor Anderson, C.E. '17, was recently appointed to the position of State Highway Commissioner of the Virginia Department of Highways. He is the fourth man to hold this post since its inception forty years ago. General Anderson has had a distinguished military career. After serving as a Lieutenant Colonel in the first World War, he joined the Virginia Military Institute as Adjunct Professor of civil engineering and drawing. In 1920, General Anderson was elevated to Associate Professor and assumed command of the entire civil engineering department of V.M.I. At the same time he was serving as town engineer for the town of Lexington, Va. In 1924 he was appointed a full professor. State Director of the Public Works Administration from 1933 to 1936, the General returned to V.M.I. and became Dean of Faculty.

Charles E. O'Rourke, C.E. '17, professor of structural engineering at Cornell died January 10, 1947, after a long illness. Prof. O'Rourke was born in New York City June 4, 1896. He served in World War I after graduation from Cornell. In 1919 he returned to the campus to teach, becoming an assistant professor in 1923 and full professor in 1934. He was active in civic affairs, and served as a consulting engineer and visiting lecturer. He also authored several textbooks. He was a member of the Cornell Society of Engineers, Pyramid, Gargoyle, Tau Beta Pi, Chi Epsilon, and Sigma Phi Sigma.

Myron Zucker, E.E. '25, has been appointed vice president of Mackworth G. Rees, Inc. of Detroit, Michigan. Mr. Zucker also holds the degree of Master of Science from Union University. He was associated with the General Electric Company from 1925 to 1929, working on testing, thyratron application development, and central station engineering. In 1929 he entered the egineering division of the Detroit Edison Company and remained with that company until 1944, when he joined Mackworth G. Rees as an engineer. Mr. Zucker is a member of the Engineering Society of Detroit.

Howard Simpson, B.C.E. '42, has just been discharged from the Navy. Before entering the Navy Mr. Simpson worked on the atom bomb at Oak Ridge, Tenn. He is at present doing graduate work in Construction and building engineering at the Massachusetts Institute of Technology, Cambridge, Mass.

John W. Baer, B.S. in A.E. (M.E.), '43, '42, has been appointed Chief Engineer for the Forker Corporation of Cleveland, Ohio. The Forker Company is the manufacturer of the Ohio Tramrail Systems. Mr. Baer spent three years with the Army Engineers. Before he entered the Army, Mr. Baer was Tool Engineer and chief draftsman for the Forker Company.

George W. Bouton, B.M.E. '42, has returned to Babcock and Wilcox Company, New York City, N. Y., as an Engineer. At Cornell, he was on the Varsity Basketball Team for thre terms ond won his "C" for his activity in that sport.

Charles H. Brumbaugh, M.E. '23, '24, has joined the Barber-Greene Company of New York City, N. Y., as Sales Engineer. Mr. Brumbaugh covers the territory included between Maine and Virginia.

Robert J. Fritz, B. ChemE. '43, is with the Standard Oil Development Company in Elizabeth, New Jersey, doing work on fuels and combustion. Mr. Fritz made the Dean's List three terms while he was at Cornell and also was a member of Al-Djebar, the Retort and Beaker and Alpha Chi Sigma fraternity.

Murray A. Sanders, M.E. '45, has been appointed Plant Manager of the Publix Metal Products Company of New York City, N. Y. Mr. Sanders has been with the company since his graduation and will now take charge of all production engineering in the New York Plant. He was quite active in Phi Sigma Delta fraternity while at Cornell, and was House President for two successive terms.

Book Review

Photography by Infrared, Its Principles and Applications, by Walter Clark, Ph.D., F.R.P.S., F.P.S.A., Kodak Research Laboratories. (Second edition—John Wiley and Sons, Inc., N. Y. 1946).

This book of 472 pages, is a thorough revision of the first edition which brings the material incorporated up to date, about February, 1946.

Photography by Infrared, covers the entire field of photography of infrared light from source of light to interpretation of results. There is discussion of light sources, latest information on films, data on use of specific lenses, directions for lighting and photographic development and chapters on the application in certain fields of technology, arts and research. These chapters are supplemented by others on characteristics of photographic materials, sensitization, etc., which give the photographer the theoretical background necessary for understanding and successful practical application. One chapter is given to photographic methods of recording infrared beyond the range of direct film sensitivity.

The subject matter is presented in an unbiased manner with cases where infrared photography has not given hoped for results (as in seeing through fog) as well as cases where great success has been obtained (as in showing fingerprints on charred paper).

Many of the applications of infrared photography will be of interest and use to engineers. Some of these are analysis of dyed fibres, application to micrography, aerial and ground surveying, forest survey to determine species of trees, determination of temperature gradients to objects below red head and study of corrosion of tin plate. The applications to criminology and study of altered documents is fascinating reading.

The many practical hints and precautions (as to the transparency of hard rubber slides in plate holders) make this book a necessity for anyone contemplating any kind of infra red photography.

Though the second edition is physically smaller than the first edition, 1939, it contains more subject matter and about 20% more references. The printing and illustrations are very fine.

—Dr. C. W. Gartlein

Protective and Decorative Coatings, Joseph J. Mattiello, editor. Volume V, Analysis and Testing Methods. ix + 662 pages. John Wiley and Sons, Inc., New York, 1946. The preceding volumes of this encyclopedic work are largely descriptive of materials and manufacturing methods. Although natural and synthetic resins are discussed in them to some extent, the 174 page chapter in the present volume on Analysis of Resins, by R. W. Stafford (A.B. '31, M.S. '32) and E. F. Williams, gives a good condensed summary of the nature, properties, and applications of these materials, that are so largely consumed by the protective coatings industry. Numerous comparative tables of physical properties are included, together with methods of physical and chemical testing.

The chapter on Analysis of Drying Oils (71 pages), by T. F. Bradley and E. L. Kropa, deals with a variety of methods; its authors emphasize the increasing necessity for determinations of many constants in order to deal with mixtures of oils, often heat-treated, partially oxidized or sulfurized, and blended with other ingredients employed in modern vehicles.

Laboratory Testing of Metal Finishes, discussed in a chapter of 97 pages by S. E. Beck, is essentially a critical survey of test procedures designed to measure durability, particularly in outdoor service. The importance of testing the entire "system" of coatings (primer and topcoats) is stressed. The reader is referred to the literature for details of experimental methods, since the author is primarily concerned with their interpretation and reliability.

In the chapter on Spectral Characteristics of Pigments (130 pages) V. C. Vesce describes a photographic method of measurement and gives tables of reflectance for four wavelength bands. Two hundred spectrophotometric curves of different pigments are included. This chapter could well be expanded to deal more specifically with applications and interpretations of such data.

The chapter on Resinography (164 pages), by T. G. Rochow (B. Chem. '29, Ph.D. '34) and R. L. Gilbert (B.Chem. '38), is worthy of development as an independent book; it deals with a subject not obviously comprised by the title of the series—the microscopy of resins. This field (analogous to metallography) is new, inadequately covered in the literature, and one to which the authors' experience has contributed greatly. Most of the examples given are of molded or laminated plastics and aggregates. The numerous photomicrographs are almost self-explanatory, and illustrate the value of close-ups in the study of manufacture and performance of products involving resins. To link it to the subject of coatings, this chapter might well have included more on primer, paint, and lacquer films on various bases, "doped" fabrics, dressings for leather and wood, coatings on papers, and other related applications of technical microscopy. Lest the reader get the impression that the microscopy of plastics requires the elaborate and expensive equipment which the authors are fortunate in being able to use, the reviewer would emphasize that a great deal of information on the structure of resin aggregates can be obtained with comparatively crude preparation methods and cheap microscopes.

Chemical and physical tests, selective solvents, color reactions, and methods of separation of powdered ingredients of plastics are also discussed in this chapter.

In spite of its heterogeneous content, Volume V is a valuable addition to the series; like the preceding volumes, it should be indispensable to all concerned with the manufacture and investigation of coatings. The writers have been chosen as authorities in their fields, the applications of theory are well interpreted, and critical comments rather than mere compilations characterize their contributions.

—Prof. C. W. Mason

NUMBER 5 OF A SERIES

Newsworthy Notes for Engineers

Why Condensers now live longer

Testing and setting standards for materials is a vital part of production at Western Electric.

Take, for example, the tissue paper —about 1/10 the thickness of a human hair—used as insulation between the turns of aluminum foil in millions of "paper" condensers for the Bell System.

Condenser life is generally in direct proportion to the quality of tissue used. In studying effects of differences in chemical composition, fibre structure, thickness, pinholes and other properties to set a standard of quality, engineers found intrinsic variables so great that a method of rating had to be developed.

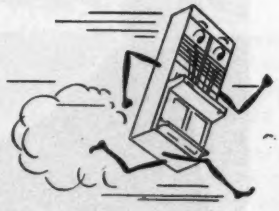
They solved this problem by making sample condensers using each type of paper and checking them at high temperatures and high voltages to determine life expectancy.

Correlating results of these accelerated life tests with manufacturing data led to improved paper making methods—paper manufacturing machines of new designs—increased production of the right kind of paper—longer-lived condensers.

It's hard to hurry a Switchboard

One of the major problems faced by Western Electric engineers in the rush to make telephone switchboards *fast* —to meet unprecedented demands—is the complexity of manufacture involved.

A recent study of what it takes to make a certain much-needed type of manual switchboard installation consisting of ten operator positions will give you some idea of the complexity. Here are the principal items of apparatus required: 5,680 relays; 19,500 jacks; 15,000 lamps of various kinds plus their lamp sockets and mounting; 17,000 lamp caps of various colors and designations; 450 mounting plates of relays, condensers and resistances; 580 resistances; 550 condensers; 360 fuses; 691 jack spaces and a total of 1,071,000 conductor feet of wire and cable!



In spite of this complexity, Western Electric is speeding switchboards on their way. Production in 1946 of manual switchboards is expected to break a record of 16 years' standing.

Problem for *Production* Engineers

Easy? Not when it means providing machine capacity for welding a billion precious metal contacts per year —*five times* the previous maximum production rate! This problem was one of the most critical faced by Western Electric engineers in meeting tremendously increased demands for telephone equipment.

A pair of these contacts is required at every point in telephone circuits where current is interrupted in switching. They minimize "noise" in your telephone receiver. They're made of bi-metal tape—the contact surface is paper-thin precious metal, usually palladium. The balance is less expensive metal such as nickel.

By providing recently developed electronic control equipment and making mechanical improvements in the precision welding machines—which must cut off small pieces of tape, accurately position them on telephone apparatus parts and weld them securely—the engineers pushed operating speeds to a new high.

Result: only about two-thirds as many hard-to-get new welding machines were needed—a half-million dollars were saved—and welds of higher quality are being produced at the rate of a billion a year!

Manufacturing telephone and radio apparatus for the Bell System is Western Electric's primary job. It calls for engineers of many kinds — electrical, mechanical, industrial, chemical, metallurgical — who devise and improve machines and processes for large scale production of highest quality communications equipment.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

Gage Laboratory

(*Continued from page* 13)

quired to inspect the body of M77 fuses. They vary in cost from $6.00 to over $600.00 each; the group is valued at $5200!

This is typical of the needs for controlling quality in modern mass production. Much has been done to make automatic "sorters" where volume production warrants it. A sizeable portion of our total production as yet does not permit this approach.

These automatic inspection devices rely upon mechanical, electrical, fluid, and/or optical schemes for their functioning. Since these are highly specialized they do not appear in our laboratory. We do possess two Multi-Checks for examining diameters and the lengths of such items as projectiles. Up to seven diameters and one length dimension are examined simultaneously. The operator merely inserts the projectile in the fixture and then slides the part into position. The mechanism is arranged to turn on a green light where any dimension is over size or a red one if under size. These measuring units may readily be adjusted to accommodate other articles, hence are quite versatile. They can be set to cover tolerances from .012″ to .000050″ and are accurate to .000005″.

When gage blocks or small parts are to be compared with some master standard, some sensitive amplifying device such as the Electrolimit Comparator (Fig. 3) is used. This uses a microammeter to detect movements of 10 millionths of an inch in the contact spindle. An impedance bridge circuit is unbalanced as the spindle is moved to effect magnification of several thousand to one of the contactor.

There are many other devices used to indicate small differences between a setting with a master gage or part and subsequent pieces.

A common scheme is to replace pivots with thin steel reeds for mechanical levers, and then to use tilting mirrors to reflect a beam of light or else a small target to cast a shadow on a chart—like a shadow pictures we used to make on the walls by manipulations of the hands.

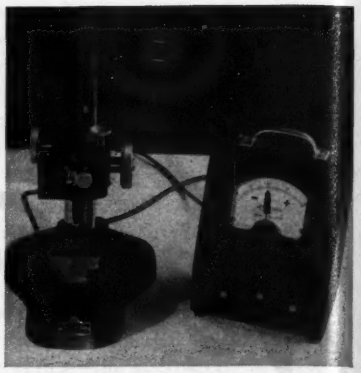


Figure 3.—Pratt and Whitney Electrolimit Comparator used to compare parts to millionths of an inch. It is shown here comparing gage blocks.

The comparators available in this laboratory include a Starrett Dial Gage for 500 to 1 magnification (reading to one thousandth of an inch), Sheffield visual for 500 to 1 and another 10,000 to 1 (reading to 25 millionths). Two Pratt & Whitney Electro limits—one for measuring to ten thousandths and another (see Fig. 3.) for measuring to 20 millionths.

There are also Electrogages which control by pre-set electric circuits

(*Continued on page* 28)

Mountain to Mohammed...

20th century version

Immovable as Mohammed's mountain is the orthodox power plant for a fair-sized city. Yet when power facilities were bombed out in Antwerp, Manila, Ghent, the power plant came to them...the mountain to Mohammed.

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There are lots of problems in building boilers for central stations that hop about. The ships must be designed for passage through narrow locks and channels. Boiler weight and size must be pared down to make room for plenty of fuel...boiler efficiency kept high to make fuel last.

B&W built the boilers for the first floating power plant, has built others like them since. In this, as in its pioneering work in many fields, B&W illustrates its two major resources: the long experience of the past...its engineering vision, the courage to have new ideas.

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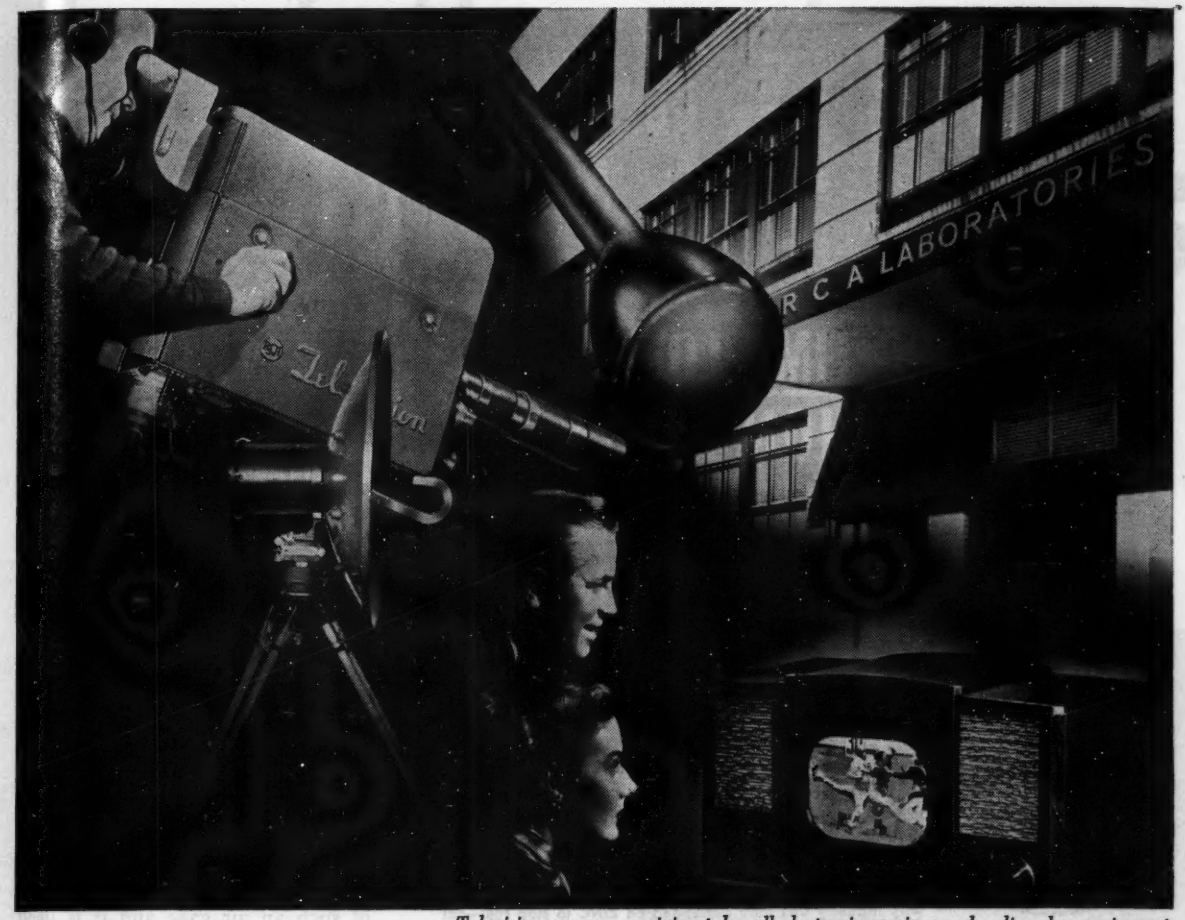

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RCA Victor Television Receiver—with the new RCA exclusive "Eye Witness" feature that "locks" the picture, keeps it bright, clear—as steady as a picture on the wall.

RCA Radio Relay equipment enables television stations to broadcast events taking place far from the studio, and eventually may link television networks. In television, as in radio, Victrola* radio-phonographs, records, or tubes, if it bears the name RCA or RCA Victor, it is one of the finest instruments of its kind science has achieved.

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American Zinc Institute

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Gage Laboratory

(*Continued from page* 26)

for flashing colored lights to indicate over, under or within limit conditions. These may be connected to an oscillator for producing tone varitions so that inspection may be done by blind operators.

During the past war the use of pneumatic gages became prominent. These gages use a plug (or ring) in which two orifices, diametrically opposed, discharge air under controlled conditions. This gaging head is restricted to tolerances less than .0020. The indicating devices registers either a change in flow of the air through the instrument or a variation in back pressure in the line, depending upon how snug or loosely the gaging head fits the part.

A peculiar property of such an instrument, aside from its almost limitless sensitivity, is that the gaging orifices do NOT touch the area being inspected. It permits the inspection of parts in process without removal of cutting fluids or protective greases. Highly finished surfaces to 5 millionths tolerances can be inspected without danger of marring the surface.

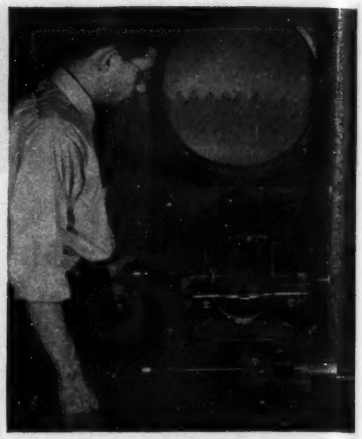

Figure 4.—Bausch and Lomb Projection Comparator, examining a thread plug gage at 25x. Magnification up to 100x is readily obtained.

Such is the nature of the operations behind the scenes in our present industrial processing of goods. By this air gage it is possible for Buick to inspect and classify an eight-cylinder engine block to .0003" limits for each cylinder in less than one minute. Here is automatic gaging—almost.

This laboratory has one element of such an air gage and it is used to demonstrate the principles of air flow commonly known as a Rotameter. Other schemes such as the Federal Metricator and Moore Nullmatic are demonstrated by charts.

Another valuable piece of laboratory equipment is the projection comparator. We are fortunate in having both a Jones & Lamson and also a Bausch & Lomb. The latter (see Fig. 4), is shown inspecting a thread plug gage at 25X. This permits examination of all thread elements except pitch diameter to .0001" and thread angle to 1 minute of arc. Magnification up to 100 to 1 are readily obtained by changing a lens mount.

This comparator is the only means we have for easily inspecting small watch and instrument parts, form tools, and type faces (by reflection). Master outlines of maximum and minimum sizes can be engraved on these screens or simple tracings may be used to permit quick and reliable quantity inspec-

(*Continued on page* 30)

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Support for wheels, shafts, gears and other rotating parts still is the primary purpose of bearings, but several other vital bearing requirements are needed in modern equipment.

Ability to carry radial loads, thrust loads or both together in any combination is one of the most important of these. Ability to hold moving parts permanently in alignment is another. Then of course there is the reduction of friction, although this quality is common, in varying degrees, to all anti-friction bearings.

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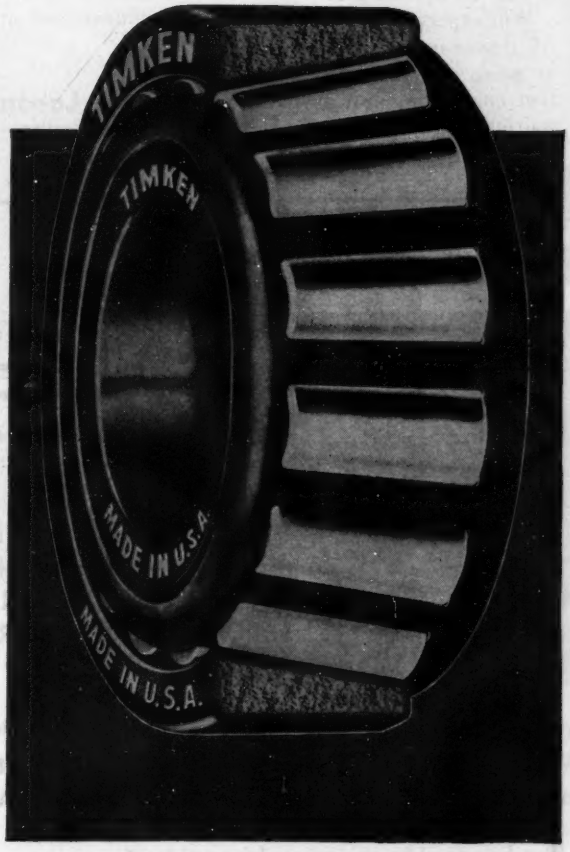

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Will Gundlach

(*Continued from page* 19)

ribbon.

Will came home to his wife and new baby, and hibernated to the woods and a cabin at Beaver Lake, New Jersey for the month of August. While there, the war ended, and his orders back to the Pacific were changed to read for a rapid discharge.

He re-entered Cornell in October 1945 as a fourth term AEME, and rejoined the varsity crew. In the Spring, Will was initiated into Sphinx Head, senior honorary society, of which he is now vicepresident. He is presently vice president of the Crew Club also.

Will expects to receive his BS in AE degree in June and is interested in going into industral or production engineering. Meanwhile, he is waiting for the Veterans Housing Project to come forth with a promised apartment dwelling, so he can move in with his wife and now-eighteen month old youngster. According to Will: "I'm not sure my son will be Cornell '67 as is hoped, but the way he's growing, he'll be a mighty good Five Man on some school's crew!" At any rate, "Skipper" has a long way to go before he fills his dad's size 12½ shoes.

Bill Wheeler

(*Continued from page* 18)

Lab dark room. He's not too certain about his post-graduation plans, but does want to settle around Chicago. Bill will graduate in February after having made quite a niche for himself, as both student and athlete, here at Cornell.

Gage Laboratory

(*Continued from page* 28)

tion. Generally a special work holding fixture is desirable to quickly orient the art to the reference data on the chart.

This series of snapshots around the laboratory should give some idea of the facilities now available. The course of instruction follows a carefully planned sequence so that each experience with the equipment provides background for the coming work.

Near the end of the program some checking of gages is included as well as a discussion of Machine Tool inspection standards and their instrumentation.

We do not enjoy the nicety of air conditioned rooms, and are incomplete in certain special fields. The existing facilities are in excellent condition and available for the staff to use in instructing engineering students, and are also serving other areas including commercial firms when precision inspection is needed.

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—RALPH WALDO EMERSON

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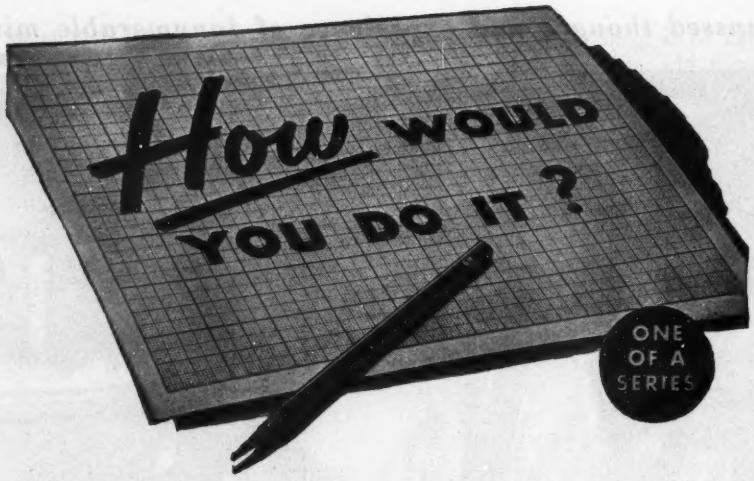
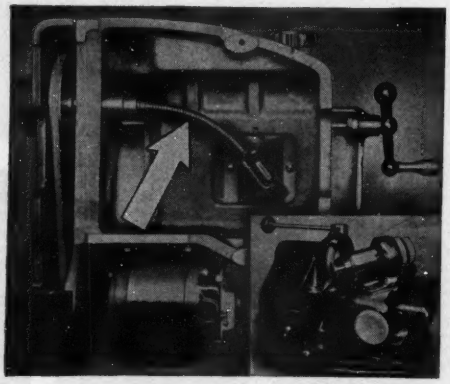


PROBLEM: You are designing a valve grinding machine. You have to provide a drive for the chuck that holds the valve stem. This chuck must be adjustable in three different directions. Your problem now is to devise a method of driving the chuck which permits these adjustments. How would you do it?

THE SIMPLE ANSWER: Use an S.S.White power drive flexible shaft to transmit power to the chuck. The shaft provides a positive, dependable drive that permits free movement of the chuck in any direction.



This is how one large manufacturer did it.

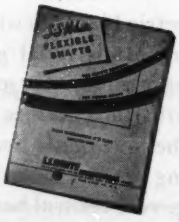
• • •

This is just one of hundreds of remote control and power drive problems to which S.S.White flexible shafts provide a simple answer. That's why every engineer should be familiar with the wide range and scope of these useful "Metal Muscles"* for mechanical bodies.

WRITE FOR BULLETIN 4501

It gives essential facts and engineering data about flexible shafts and their application. A copy is yours free for the asking. Write today.

*Trade Mark



S.S.WHITE INDUSTRIAL DIVISION

THE S. S. WHITE DENTAL MFG. CO. — DEPT. C, 10 EAST 40th ST., NEW YORK 16, N. Y.

FLEXIBLE SHAFTS • FLEXIBLE SHAFT TOOLS • AIRCRAFT ACCESSORIES
SMALL CUTTING AND GRINDING TOOLS • SPECIAL FORMULA RUBBERS
MOLDED RUBBERS • PLASTIC SPECIALTIES • CONTRACT PLASTICS MOLDING

One of America's AAAA Industrial Enterprises

College News

(*Continued from page* 16)

cal Engineering. Mr. Kyle received the degrees of Mechanical Engineer and of Master of Science in Mechanical Engineering from M.I.T. From 1933 to 1934 he held the James Ward Packard Fellowship in Mechanical Engineering at Lehigh University. From then to 1946 he was on the staff at M.I.T. at which he was appointed Associate Professor in 1944. He has been actively engaged in the working of a good many technical committees in the field of metallurgy, including the British Air Commission and the U. S. War Metallurgy Committee during the war.

PROFESSOR O. J. SWENSON of the Chemical Engineering faculty resigned in June, 1496. He was a member since September, 1938.

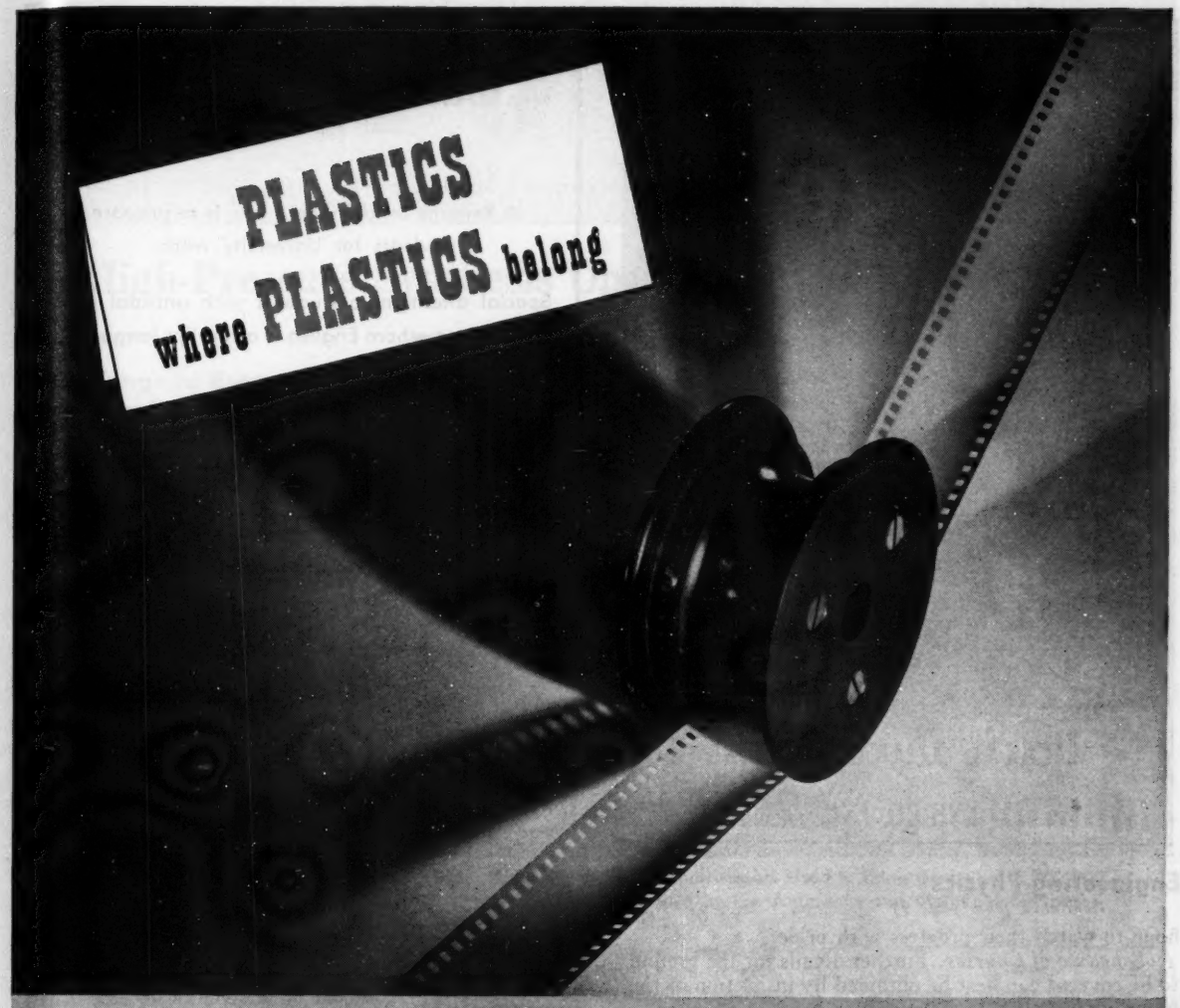
Horace Sibson

(*Continued from page* 11)

on the trail for about 25 days with pack horses, two wranglers, a cook, a guide, and the loaded pack. One of the group wrote, "One of the most thrilling experiences was swimming across the Saskatchewan River, about three fourths of a mile wide, glacial water, the current 15 miles per hour, and depth over our heads. To plunge into an icy stream sitting on a horses' back, and going into a depth that covered the horse's head, was an experience that I would not care to repeat." At that time, the party was the second ever to make the trip into the wilds of the Columbian Ice Fields. Some one said, "As those of us who have known Sib over a period of many years can testify, this trip proved him to be as fine a sportsman as he is a gentleman and friend."

Mr. Sibson's unfailing devotion to Cornell University was always in evidence. His final gesture was to aid his school so that it might continue to produce engineers and men trained in their fields as he was trained in his.

THE CORNELL ENGINEER *wishes to express its appreciation to Mr. Howard Ludington Ag '17 for his aid and information about Horace E. Sibson.*



Using Corrosion Resistance, Strength, and Machinability

MOVIE FILM carriers are an excellent example of using plastics where plastics belong.

The film carrier illustrated is only one of many types made from Synthane laminated plastics. Synthane is well-suited for the job because it stoutly resists the corrosive action of developing solutions.

The teeth, though small, must be strong and accurately indexed. They are easily milled from Synthane.

Whenever in your future work you have an application for laminated plastics, let us know about it—*before* you design, if possible.

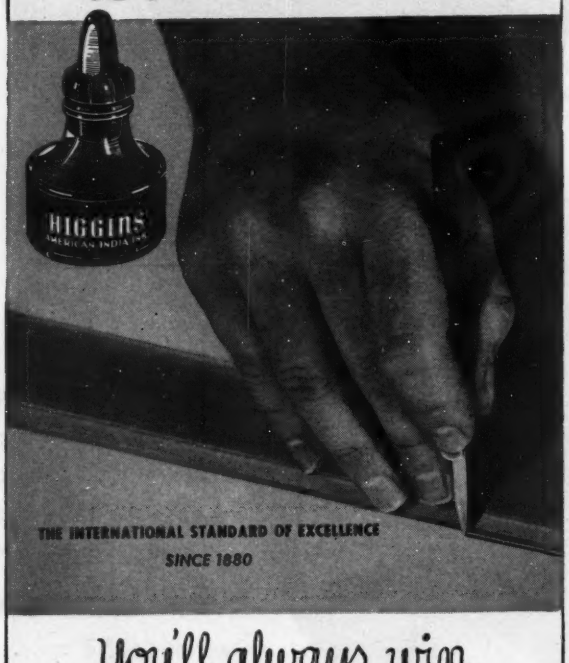
Synthane's help includes design, selection of the right material, and fabrication by men who know plastics. Synthane Corporation, Oaks, Penna.

SYNTHANE TECHNICAL PLASTICS DESIGN • MATERIALS • FABRICATION

SHEETS · RODS · TUBES · FABRICATED PARTS · MOLDED-MACERATED · MOLDED-LAMINATED

SYNTHANE

Lay it on the line



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A Regents School where aim is to prepare students for University work.

Special attention to students with unusual programs or to whom English is a foreign language.

University Tutoring

Tutoring in university courses that is effective because directed to individual needs.

Special attention given to the needs of veterans

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MAXWELL T. KENDALL '36, *Headmaster*

Engineering Physics

(*Continued from page* 9)

hope to watch their progress with pride.

Schedule of Courses: Further details for the ground to be covered can best be obtained by inspection of the following initial table of courses:

		Credit Hours
Term 1		
Math. 60a	Analytic Geometry and Calculus	3
Phys. 15	Mechanics	3
Chem. 102a or 104a	General Chemistry	3
Eng. 2a	English	3
M.E. 3114	Drawing	2
	Language (elective)	3
M.E. 3403	Fundamentals of Machine Tools	1
		18
	Military Science and Tactics	
	Physical Training	
Term 2		
Math. 60b	Analytic Geometry and Calculus	3
Phys. 16	Wave Motion, Sound and Heat	3
Chem. 102b or 104b	General Chemistry	3
Eng. 2b	English	3
M.E. 3115	Drawing	2
	Language (elective)	3
6111	Metal Working	1
		18
	Military Science and Tactics	
	Physical Training	
Term 3		
Math. 60c	Analytic Geometry and Calculus	3
Phys. 17	Electricity and Magnetism	3
Chem.E 5761	Organic Chemistry	2
Phys. 65	Mechanics and Properties of Matter	3
	Statics and Strength of Materials	3
	Liberal Elective	3
		17
	Military Science and Tactics	
	Physical Training	
Term 4		
Math. 200	Differential Equations	3
Phys. 18	Electricity, Magnetism and Light	3
Chem.E. 5762	Physical Chemistry	2
	Statics and Strength of Materials	3
4111	Electric and Magnetic Circuits (modified)	3
	Liberal Electives	3
		17
	Military Science and Tactics	
	Physical Training	
Term 5		
Phys. 111	Analytical Mechanics	3
Phys. 123	Electricity and Magnetism	3
4112	Electric and Magnetic Circuits (modified)	3
4116	Electric Circuit Laboratory	3
1221	Engineering Materials	3
8121	Thermodynamics and Kinetic Theory	3
		18
Term 6		
Phys. 124	Electricity and Magnetism	3
1162	Mechanics of Vibrations	3
1222	Engineering Materials	3
8122	Thermodynamics and Kinetic Theory	3

(*Continued on page* 36)

Du Pont Digest

Items of Interest to Students of Chemistry, Engineering, Physics, and Biology

High-Pressure Synthesis Opens New Chemical Fields

A Challenge to Research Men and Engineers

The use of techniques involving pressures up to and above 1,000 atmospheres (15,000 lbs. per sq. in.) has had a tremendous influence on chemical manufacture in the past twenty-five years.

The availability of unlimited quantities of nitrates via ammonia from nitrogen of the air by high pressure synthesis has greatly affected chemical economics as well as agriculture.

The plastics industry, too, has benefited greatly by the reduction in price of urea from about 80¢ lb. to less than 4¢, and methanol (to give formaldehyde) from $1.25 gal. to less than 25¢.

High pressure syntheses have also participated in a major way in the development of entirely new products such as nylon and polythene. In fact, starting from coal, air and water, Du Pont now makes over 120 widely used products.

In addition to improving the existing processes of manufacturing ammonia, methanol, higher alcohols, urea and other important chemicals, Du Pont organic and physical chemists, chemical, mechanical and metallurgical engineers have discovered and developed high pressure syntheses for the following: ethylene glycol; hexamethylene diamine; acetic, propionic and hydroxyacetic acids; methyl formate; C_8-, C_{10}- and C_{12}- alcohols; and numerous others.

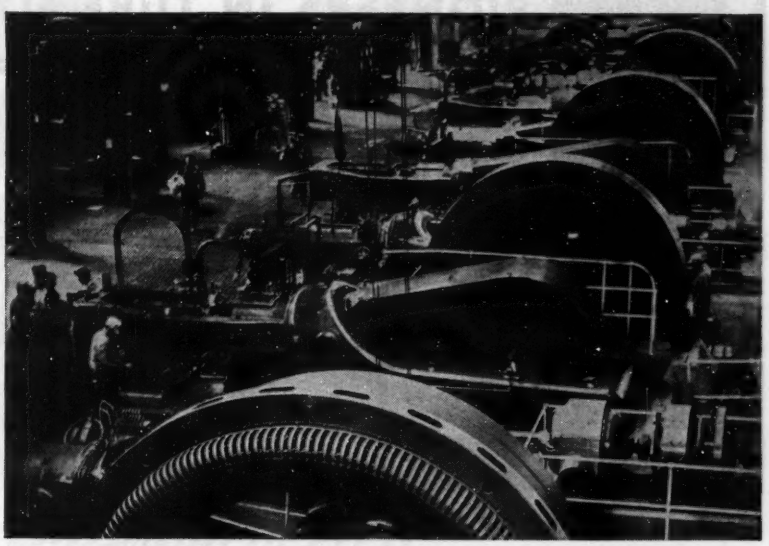
Advantages and Problems

The use of high pressures offers numerous advantages familiar to technical students, such as: (1) forcing an equilibrium in the direction of a volume decrease, (2) overcoming the reversing effect of high temperatures in exothermic reactions, (3) increasing reaction and through-put rates and (4) providing, in some cases, a liquid phase which might not otherwise be present.

The synthesis of urea from carbon dioxide and ammonia is a good illustration of some of these principles:

$$CO_2 + 2NH_3 \rightleftharpoons CO(NH_2)_2 + H_2O$$

With three moles of reactants and only two of resultants, increase of pressure gives an expected increase in conversion.



A Battery of Hyper Compressors Used to Bring Gases up to 700-900 Atmospheres Pressure in the Ammonia and Methanol Syntheses.

At the same time, the gaseous reactants are forced into the liquid phase to give higher concentrations and again better conversion. The reaction rate and therefore the rate of passage through the reaction chamber are both increased by increasing the temperature under high pressure conditions. There are other equilibrium considerations that affect the industrial production of urea, but they are too lengthy to discuss here.

Along with its advantages, the use of high pressure gives rise to problems that often severely tax the abilities of engineers and chemists. For example, (1) difficulties of design of packing glands, valves, connecting rods, closures, etc., increase rapidly with increased pressure, (2) extraordinary corrosion problems arise in which even stainless steels are attacked and cannot be used, (3) ordinary steels are permeable to hydrogen at higher pressures and temperatures. These are but a few illustrations of the challenge that high pressure studies present to the technical man and particularly to the metallurgical and mechanical engineer.

High pressure synthesis has now become a separate field of industrial chemistry with an apparently limitless future.

Questions College Men ask about working with Du Pont

What kind of a technical organization does Du Pont have?

There are ten manufacturing departments in Du Pont, each operating as a separate organization and each with its own research and engineering staff. In addition, there is a central chemical department and a central engineering department. Consequently there is a wide variety of research and engineering work available to chemists, engineers and other technical specialists. For further information write for the new booklet "The Du Pont Company and the College Graduate," 2521 Nemours Bldg., Wilmington, Delaware.

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BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

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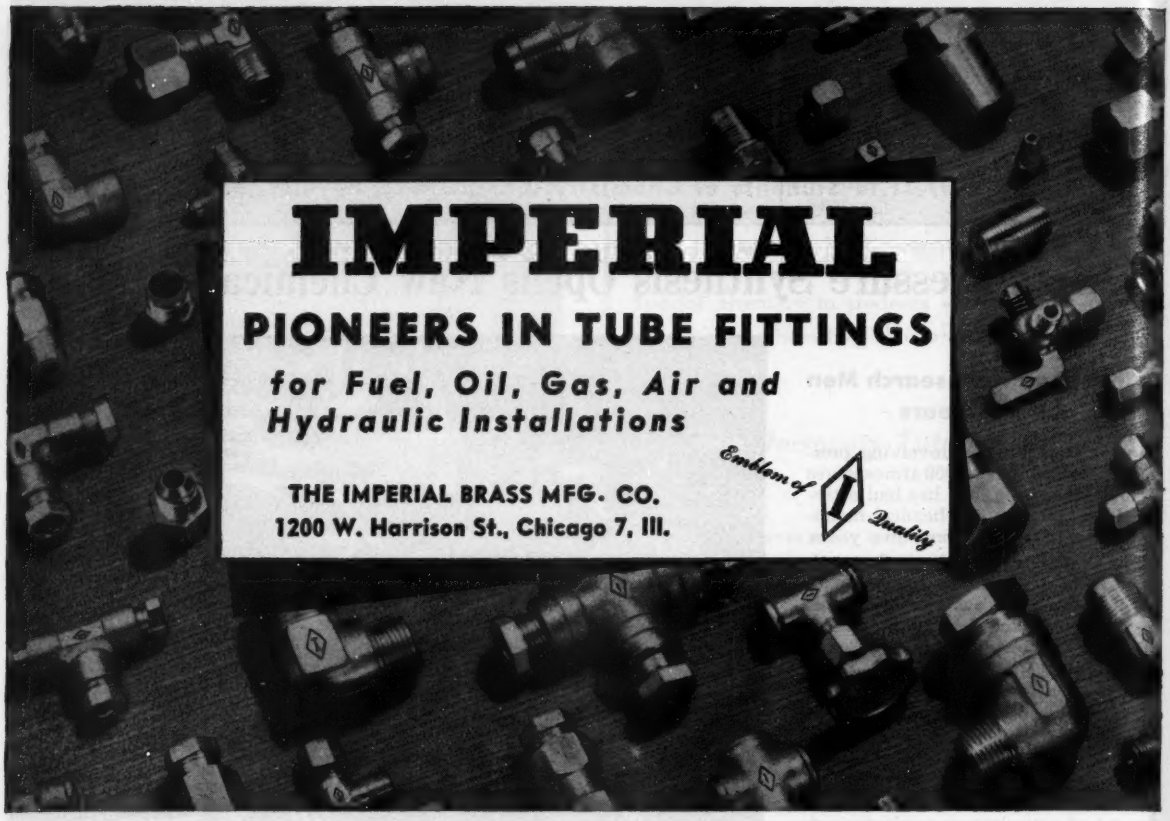
More facts about Du Pont—Listen to "Cavalcade of America," Mondays, 8 P.M. EST, on NBC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PIONEERS IN TUBE FITTINGS
for Fuel, Oil, Gas, Air and
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THE IMPERIAL BRASS MFG. CO.
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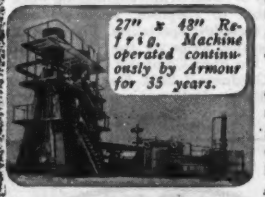
Emblem of Quality

"Send me ten dollars of Maryland money"

Frick Steam Engine, built in 1856, now in the Ford Museum.



27" x 48" Refrig. Machine operated continuously by Armour for 35 years.

Large 4-Cylinder Frick Compressors of today with 300-h.p. Motors.

So writes one of our customers in December, 1860. Living south of the Mason-Dixon Line, he complained of "Harrisburg bills" that "We cannot do anything with that money here."

This was seven years after George Frick had established his steam engine business (1853). The Company which still bears his name has since lived through four wars and many nationwide financial crises.

In 1882 Frick Company began making the refrigerating machinery which is now the standard of excellence throughout the world. Many of the Frick compressors built forty or fifty years ago are still in daily operation. One of them has been on the job nearly 60 years.

That's the kind of reliability only FRICK equipment gives. Write for literature.

The Frick Graduate Training Course in Refrigeration and Air Conditioning, now in its 30th year, is approved under the G.I. Bill of Rights.

Frick Co., Waynesboro, Pa.

Engineering Physics

(*Continued from page* 34)

4121	Electronics	3
	Liberal Elective	3
		18
Term 7		
(Math. 271	Fourier Series and Transforms	3)
or	or	
(Math. 215	Advanced Calculus	3)
Phys. 173	Atomic Physics	3
1231	Materials	3
New Course	Electrical Machinery	3
4122	Electronics	4
	Liberal Elective	3
		19
Term 8		
Phys. 174	Electronic Properties of Matter	5
New Course	Electrical Machinery	3
(4511	Radio and Communication Theory	3)
or	or	
(4513	Communication Networks	3)
(Math. 215	Advanced Calculus	3)
or	or	
(	Technical Elective	3)
	Technical Elective	2
	Technical Elective	3
		19

(*Continued on page* 40)

THE MARCH OF SCIENCE

MIRACLE HEAT— without fire or furnace!

HEATING A PIECE OF METAL BY OPEN FLAME, BLOW-TORCH OR FURNACE IS RELATIVELY SLOW— APT TO LEAVE SCALE... IT'S HARD TO HEAT ONE SPECIFIC AREA WITHOUT HEATING THE WHOLE PIECE.

PRODUCTION MEN REALIZED HEAT-TREATING OPERATIONS SUCH AS FORGING, PRECISION BRAZING AND SURFACE HARDENING COULD BE STEPPED WAY UP IF A FASTER METHOD OF HEATING COULD BE FOUND... ONE WHICH WOULD CONCENTRATE THE HEAT AT PRE-SELECTED AREAS!

HEAT BY INDUCTION SEEMED LIKE THE ANSWER. SCIENCE HAD ALREADY DISCOVERED THAT METALS HEAT RAPIDLY WHEN INTRODUCED INTO A HIGH FREQUENCY, HIGH DENSITY MAGNETIC FIELD!

A NEW ELECTRONIC HEATER DESIGNED BY ALLIS-CHALMERS SCIENTISTS—

AMAZING PRODUCTION TOOL RECTIFIES ORDINARY 60-CYCLE CURRENT THEN STEPS IT UP TO 450,000 CYCLES. A MAGNETIC FIELD OF HIGH DENSITY IS SET UP IN WORK COIL AND WHEN METAL IS INTRODUCED INTO THIS FIELD, PASSAGE OF CURRENT CAUSES POWER LOSSES WHICH PRODUCE HEAT WITHIN THE METAL WITH INCREDIBLE SWIFTNESS.

BIG BENEFITS: COMPLETE, SELECTIVE CONTROL OF HEAT PENETRATION... EXACT UNIFORMITY... GREATLY INCREASED PRODUCTION!

SIMPLE AS

A PLACE METAL IN WORK COIL...

B PUSH BUTTON

C METAL IS HOT IN SPLIT SECONDS

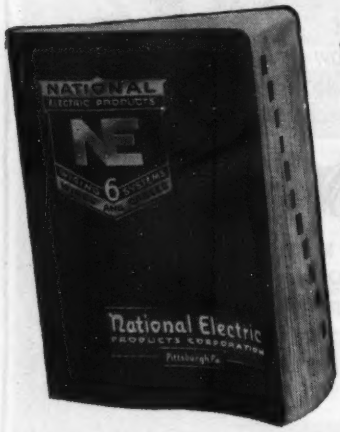
ALLIS-CHALMERS MANUFACTURING CO. MILWAUKEE 1, WIS.

ELECTRONIC HEATER IS ONE MORE EXAMPLE OF HOW ALLIS-CHALMERS RESEARCH AND EXPERIENCE GO TO WORK FINDING BETTER, FASTER, MORE EFFICIENT WAYS OF HANDLING PRODUCTION PROBLEMS—ANOTHER GOOD REASON WHY A-C EQUIPMENT IS IN DEMAND IN EVERY MAJOR INDUSTRY...

ALLIS CHALMERS

ONE OF THE BIG 3 IN ELECTRIC POWER EQUIPMENT
BIGGEST OF ALL IN RANGE OF INDUSTRIAL PRODUCTS

Attention ENGINEERS!



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NE's
FREE
ELECTRICAL
DATA
HANDBOOK

Here's a 350-page, 8" x 10" handbook that is invaluable to electrical engineers. It's an illustrated, products and parts catalog. Has handy reference tables, wire and cable terminology, formulas, specifications, electrical symbols for architectural planning, as well as wiring systems for industrial, commercial, and domestic requirements. Write for *your* copy.

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PRODUCTS CORPORATION
Box 897 — Pittsburgh 30, Pa.

Bridge Construction

Project: High level multispan bridge over Youghiogheny River, Somerfield, Pa., part of National Highway, Route No. U.S. 40. (Shown) Concrete piers before erection of steel. Completed 1946.

Cayuga Construction Corp.

30 Vesey Street, New York 7, N. Y.

Daniel M. Lazar '29, *President* — L. Sanford Reis '29, *Treasurer*

Dr. Bacher

(*Continued from page* 17)

used by Alverez in California and by Moon in England. He extended the energy range to which this instrument is applicable from the previous limit of .05 ev to about 50 ev, and obtained the first satisfactory resolution of a neutron's resonance level. He was able to determine the velocity of a free neutron, by timing it as it sped across the lab. It takes a neutron about one-ten thousandth of a second to do this, and the instrument measures time to around one-millionth of a second.

Professor Bacher, in his war work and in his peacetime work in physics has shown keen appreciation for what is possible and has then achieved results recognized as possible in the most straightforward and competent way. He has come up fast, being only 41 today. In 1937 he was made an Assistant Professor of Physics after being here only two years, and two years later he was made an Associate Professor of Physics. Since 1945 he has been a Professor of Physics and Director of the Laboratory of Nuclear Studies.

Bacher has been almost constantly in active contact with Cornell since he first arrived here. He went on leave in 1940 to head a section of radar receiver and indicator components and radar beacons at M.I.T. While there, Prof. Bacher kept frequent contact with Cornell and directed a part of the Manhattan District's project which had been assigned here. Cornell's part was terminated in 1942.

After the bomb had been produced, Prof. Bacher added to his combination of scientist, administrator, and "common sense engineer" by taking an active part in the political aspects of the Atomic Situation. He served as Scientific Consultant to the United States Representative to the United Nations Atomic Energy Commission, and on many other committees, advising on both the technical and political aspects concerned. He is a trustee, Member of the Executive Committee, and Chairman of the Planning Committee, Associated Scientists Incorporated (operating the new Brookhaven National Laboratory at Camp Upton, New York). And last October, Prof. Bacher was appointed by President Truman to the 5-man Atomic Energy Commission, which will set the plans and controls on the uses of Atomic Energy in this country.

Friends of Prof. Bacher have said that he had intended to return to Cornell after the War and continue research, but he realized that the political control of atomic energy was of such importance that he could hardly refuse to take an active part in that control, which of course means that he cannot retire to the strictly scientific end. The appointment to the Commission came as a surprise to Bacher, but he has accepted and pledged to do his best in obtaining the benefits of atomic energy without suffering from its destructive efforts in war.

As for the future of Atomic Energy, Bacher said, "While the development of atomic energy for industrial purposes is just getting started, even conservative estimates of the possibilities for the future seem very promising."

HANNIBAL'S FROZEN ASSET

The Romans smugly thought the icy barrier of the Alps impassable. But Hannibal turned the paralyzing cold to his advantage. He had water poured into the crevices of road-blocking boulders. The expansion of the freezing water "made little ones out of big ones"—and another road led to Rome.

Low temperature, which worked to Hannibal's advantage, is a distinct disadvantage to operating machinery. Under low temperature conditions, some steels that may perform perfectly at ordinary temperatures, develop unsuspected weakness. There is always danger of a parts failure under such conditions.

One way to assure good performance at low temperatures is to specify molybdenum steels. Good hardenability plus freedom from temper brittleness give them good low temperature impact strength. They are a precaution it pays not to ignore. Practical working data are available on request.

MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"
CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

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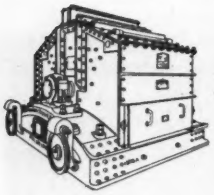
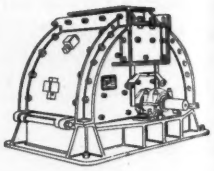
LIBERTY TRUST BUILDING, PHILADELPHIA, PA.
NEW YORK PITTSBURGH CHICAGO LOS ANGELES
Associated with Fraser & Chalmers Engineering Works, London.

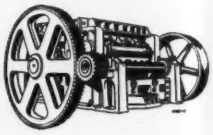


HAMMERMILLS "Pennsylvanias" are built REVERSIBLE, an *exclusive* feature. Change from *right* to *left* hand rotation by Motor switch. For Limestones, Cement Rocks, Gypsums and wide variety of Chemicals and Industrial Minerals. Automatic Hammer "turning." Adjustable Cages . . . Tramp Iron protection. Steelbuilt. Patented. In capacities up to 500 TPH. Bulletin No. 1030.



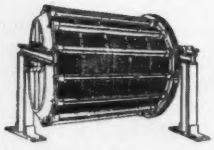
IMPACTORS An advanced new type that reduces by hard-hitting *Impact*. For reducing difficult Electric Furnace Refractories, a wide range of Ferro products, Slags, Chrome Ores, Chemicals and Industrial Minerals. Low *overgrinding*, high cubing particle shape. Patented. Bulletin No. 6015.

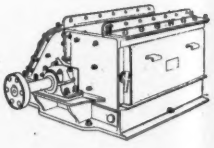
DOUBLE REDUCTION CRUSHER A powerful, two-stage-in-one double reduction unit for crushing "one-man" stone, Industrial Minerals, Chemicals, etc.
When suitably equipped, it becomes a highly specialized unit for crushing heavy and light steel turnings.



SINGLE ROLLS An advanced Steelbuilt design specialized for 2-stage reduction of Coal; several sizes for Mines, Gas Works and Power Plants. For Chemicals and Industrial Minerals. Also powerfully Steelbuilt for primary and secondary reductions of Cement stones, etc. Tramp Iron protection. Quick sizing adjustability. Several sizes in capacities up to 800 TPH. Several Bulletins.

BRADFORD BREAKERS Reduce R.O.M. for Stoker or Pulverizer feed with absolutely no oversize and low "overgrinding." Crush by gravity-impact. Automatically eject, without damage, tramp iron, mine debris and hard rock. Low H.P., slow speed, rugged construction, low up-keep. Without any qualification, we consider this the most dependable type heavy duty Coal Crusher ever designed. 25 to 1500 T.P.H. Steel built. Patented. Bulletins.





GRANULATORS Granulate materials of medium hardness . . . Bituminous coal. . . . Gypsum Rock, etc., to produce sizes ⅛" to 2", with minimum fines and oversize. Operation practically dustless. Steelbuilt. Patented. Bulletin No. 9000.

BRADFORD-HAMMERMILLS A highly specialized Coal Crusher for Power Stations. Patented. Bulletin available.

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As the term draws to a close, sort out the books which you have used this term and in previous terms, which you do not wish to retain.

Then, bring them to the Co-op and let us purchase these books for CASH.

You will help yourself, by turning unwanted books into CASH.

You will help some other student who may need these very books and who may be unable to obtain them in any other way, due to the book shortage.

BRING THEM IN SOON !

◆

THE CORNELL CO-OP

Barnes Hall On The Campus

Engineering Physics

(*Continued from page* 36)

Term 9		
(Phys. 405	Mathematical Methods	3)
or	or	
(Math. 480	Differential Equations of Math. Physics	3)
(Phys. 135	Optics	5)
or	or	
(	Research Project	5)
New Course	English Composition	3
Phys. 320	Special Topics Laboratory	2
	Technical Electives	6
		19
Term 10		
(Phys. 405	Mathematical Methods	3)
or	or	
(Math. 480	Differential Equations of Math. Physics	3)
(	Research Project	5)
or	or	
(Phys. 165	Wave Motion and Sound	5)
	Technical Electives	6
	Liberal Elective	3
		17

WE WISH ALL OUR FRIENDS

A HAPPY
and
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STRESS and STRAIN...

"Yes," said the undertaker, "college boys are the easiest. They are generally stiff when I get them."

* * *

I think that I shall never see
A girl refuse a meal that's free;
A girl with hungry eyes not fixed
Upon a drink that's being mixed;
A girl who doesn't like to wear
A lot of junk to match her hair;
But girls are loved by guys like me
'Cause damn if I will kiss a tree.
P.S.—Oh yeah, who was that date of yours last Saturday night?

* * *

It is told of Mr. Finnegan that he died, and when he greeted Saint Peter he said, "It's a fine job you've got here for a long time."

"Well, Finnegan," said Saint Peter, "Here we count a million years as a minute and a million dollars as a cent."

"Ah," said Finnegan, "I am needing cash. Lend me a cent."

"Sure," said Saint Peter, "Just wait a minute."

* * *

Co-ed (holding a cookies above a dog):

"Speak! Speak!"

Dog: "What'll I say?"

* * *

Inmate (at insane asylum after flunking Heat Power with fifty-nine): "We like you better than the last doctor."

New Doctor (flattered): "How is that?"

Inmate: "You seem more like one of us."

* * *

Sign noticed in Ithaca eatery: "Please pay if served."

* * *

Dinner guest at Engineer's banquet, "Will you pass the nuts, professor?"

Preoccupied Professor: "I suppose so, but I really should flunk most of them."

And then there was the Double-E who was so dumb he thought logarithm was a lumber camp song.

* * *

Newton's thirty-third law: The dimmer the porch light, the greater the scandal-power.

* * *

Things are so bad in the Temporary Veteran's Dorms that a Chemical Engineer went into a telephone booth so he would have a place to call home.

* * *

A Professor in the Arts School, wanting to quiet a Monday morning class, rapped on the desk and yelled, "Gentlemen, order!"

The entire class shouted, "Beer!"

* * *

Law Student (arrested for speeding):

"Hello, judge! How are you this morning?"

"Fine—Thirty dollars."

* * *

A cute little trick from St. Paul
Wore a newspaper dress to a ball.
The dress caught fire,
And burned her entire
Front page, sporting section, and all.

* * *

"Gee! That apple had a big worm in it!"

"Here—Take a drink of water to wash it down."

"Nothing doing. Let him walk."

* * *

Frosh Engineer: "I can't see what keeps girls from freezing."

Balch Date: "You're not supposed to."

* * *

"Of course, I wouldn't say anything about her unless I could say something good. And, boy, is this good . . . !"

* * *

A Cornell grad died of a broken neck. Seems as though he had an alcohol rubdown and tried to lick it off.

A pair of Texas recruits were taking their first trip cross-country. They landed in St. Louis and a little red truck dashed out to refuel the plane. At Cleveland, the second stop, a little red truck dashed alongside the plane as it landed. The third landing was at Albany, N. Y., and the same thing happened. The first recruit looked at his watch and turned to his companion: "This plane," he observed, "is making wonderful time."

"Yep," answered the other, "and the little red truck isn't doing bad, either."

* * *

A small boy was leading a donkey down the road through an Army camp. Some soldiers, thinking to have some fun, attempted to engage the kid in conversation. He wouldn't respond. Finally, one of them asked, "Why are you holding onto your brother so tightly?"

And then the kid came right back. "So he won't run off and join the Army," said he without blinking an eye.

* * *

EE: Could I try on that blue tweed suit in the window?"

Clerk: "We'd rather you'd use the dressing room."

* * *

Mr. Watson fondly kissed his wife farewell as he was about to catch his morning bus. But due to circumstances beyond his control, he missed his first bus in five years. Thinking it would be a pleasant surprise, he tiptoed back into the kitchen and planted a tender kiss on the back of her sweet neck as she was washing the dishes.

"Good morning," she responded. "I'll have two bottles of milk and a pint of cream."